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National Institutes of Health
1972
annual report

NIH

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U.S **National Institutes of Health**

1972
annual report

July 1, 1971 - June 30, 1972

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PREFACE

The National Institutes of Health, a component of the Department of Health, Education, and Welfare, is the principal agency of the Federal government responsible for biomedical research, communication of biomedical knowledge, and education for the health professions.

To permit full dissemination of information on its responsibilities and accomplishments this Annual Report for Fiscal Year 1972 is published. Appropriate tables showing appropriations, grants and other extramural awards, and personnel levels have been included.

It is hoped this publication will serve as a ready reference volume for those concerned with NIH activities.

Robert Q. Marston, M.D.

Robert Q. Marston, M.D.
Director

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NATIONAL INSTITUTES OF HEALTH

Officers

as of

June 30, 1972

Robert Q. Marston, M.D.	Director
John F. Sherman, Ph.D.	Deputy Director
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Robert W. Berliner, M.D.	Associate Director for Intramural Research
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Thomas J. Kennedy, Jr., M.D.	Associate Director for Program Planning and Evaluation
Thomas C. Chalmers, M.D.	Associate Director for Clinical Care
Leonard D. Fenninger, M.D.	Associate Director for Health Manpower
Leon M. Schwartz	Associate Director for Administration
Storm Whaley	Associate Director for Communications
Irving Goldberg	Director of Information
Frank J. Rauscher, Jr., Ph.D.	Director, National Cancer Institute
Carl Kupfer, M.D.	Director, National Eye Institute
Theodore Cooper, M.D.	Director, National Heart and Lung Institute
Dorland J. Davis, M.D.	Director, National Institute of Allergy and Infectious Diseases
G. Donald Whedon, M.D.	National Institute of Arthritis, Metabolism, and Digestive Diseases
Gerald D. LaVeck, M.D.	Director, National Institute of Child Health and Human Development
Seymour J. Kreshover, D.D.S.	Director, National Institute of Dental Research
David P. Rall, M.D.	Director, National Institute of Environmental Health Sciences
DeWitt Stetten, Jr., M.D.	Director, National Institute of General Medical Sciences
Edward F. MacNichol, Jr., Ph.D.	Director, National Institute of Neurological Diseases and Stroke
Thomas C. Chalmers, M.D.	Director, Clinical Center
Arnold W. Pratt, M.D.	Director, Division of Computer Research and Technology
Stephen P. Hatchett, Ph.D.	Director, Division of Research Grants
Thomas G. Bowery, Ph.D.	Director, Division of Research Resources

Roger D. Estep, Ph.D.	Director, Division of Research Services
Milo D. Leavitt, Jr., M.D.	Director, Fogarty International Center for Advanced Study in the Health Sciences
Kenneth M. Endicott, M.D.	Director, Bureau of Health Manpower Education
Peter L. Eichman, M.D.	Deputy Director
Charles H. Boettner, M.D.	Associate Director
Daniel F. Whiteside, D.D.S.	Associate Director
Eugene A. Confrey, Ph.D.	Associate Director for Policy Studies
Thomas D. Hatch	Director, Division of Allied Health Manpower
Harry W. Bruce, Jr., D.D.S.	Director, Division of Physician and Health Professions Education
Jessie M. Scott	Director, Division of Nursing
John C. Greene, D.M.D.	Director, Division of Dental Health
William A. Lybrand, Ph.D.	Director, Division of Manpower Intelligence
Martin M. Cummings, M.D.	Director, National Library of Medicine
Melvin S. Day	Deputy Director
Charles F. Bridgman, Ph.D.	Associate Director for Audiovisual Tele-Communications and Director of National Medical Audiovisual Center
Albert Feiner	Associate Director for Research and Development and Director of Lister Hill National Center for Biomedical Communications
Henry M. Kissman, Ph.D.	Associate Director for Specialized Information Services
Leroy L. Langley, Ph.D.	Associate Director for Extramural Programs
Joseph Leiter, Ph.D.	Associate Director for Library Operations
Davis B. McCarn	Acting Associate Director for Science Communications and Office of Computer and Engineering Services

National Institutes of Health

Year in Review

The National Institutes of Health during Fiscal Year 1972 continued to advance knowledge for improvement of human health.

It was a year of resurgent interest in biomedical research and health manpower, triggered by the President's health initiatives announced in early 1971. Among the highlights of this resurgence were the National Cancer Act of 1971 and the Comprehensive Manpower Training and Nurse Training Acts. The first of these established a new cancer program at NIH and authorized $1.6 billion over the next three years to advance the national effort against cancer. The manpower and nurse training acts had common aims: to help firm up the financial underpinning of our health professions and educational institutions; to increase the supply of health professionals; to introduce innovative training methods that would effect a more equitable distribution of health manpower by geography and specialty; and to encourage more disadvantaged and minority young people to enter health careers.

HEW Secretary Elliot L. Richardson paid NIH a visit on December 20, 1971, during which he noted that the Department intended "to maintain and strengthen the role of NIH in the conduct and support of basic research," and saluted the intramural and extramural programs as "among the very best administered in Government."

The Secretary reported in early February that NIH would assist in the implementation of the new agreement between the United States and the Soviet Union, announced in Moscow by President Nixon, to expand collaboration in the study of cancer, heart disease, and environmental problems. The NIH components designated to carry out the assignment are the National Heart and Lung Institute, the National Cancer Institute, the National Institute of Environmental Health Sciences, and the Fogarty International Center. The collaboration was later initiated through a U.S.–U.S.S.R. Joint Committee for Health Cooperation.

Minority Activities

An Upward Mobility College was established on the NIH campus in cooperation with the Federal City College's Division of Community Education. A full schedule of classes 12 months a year may lead to a Bachelor's degree or an A.A. certificate. Tuition, books, and fees are financed entirely by NIH, and tutorial and counseling services are available. Beginning with 250 students, UMC was expected to double its enrollment by the start of the second year and expand to about 700 students within two more years.

There was heightened activity under the Equal Employment Opportunity Program. Numerous meetings, conferences, and workshops were held to explain policies and procedures and to answer complaints. Recruitment of women and minority group members at higher level positions was emphasized.

The National Institute of General Medical Sciences offered a new fellowship plan, known as the Minority Access to Research Careers (MARC) Program. This complements another NIH program administered by the Division of Research Resources, the Minority Schools Biomedical Support (MSBS) Program, which awards funds to strengthen the biomedical research capability of minority colleges, universities, and professional health schools. And the National Cancer Institute sponsored a 3-day conference designed to improve communication with schools having a high percentage of minority students, acquainting them with NCI research programs and exploring in some detail those programs that might be of benefit to minority institutions and the NCI.

Honors and Awards

Secretary Richardson presented honor awards to two NIH staff members at the DHEW Annual Honor Awards Ceremony held in Baltimore. Dr. John R. Seal, Scientific Director, National Institute of Allergy and Infectious Diseases received the Distinguished Service Award; Dr. Seymour J. Kreshover, National Institute of Dental Research Director, was given the Distinguished Service Medal.

The Secretary also recognized two NIH scientists as recipients of another major award given during the past year—the Arthur S. Flemming Award. The Flemming Awards honor outstanding young men and women in the Federal Government, and were presented to Dr. Jacqueline Whang-Peng, National Cancer Institute, and Dr. Richard M. Asofsky, National Institute of Allergy and Infectious Diseases.

Dr. Makio Murayama of the National Institute of Arthritis and Metabolic Diseases was named a recipient of one of the first Rev. Dr. Martin Luther King, Jr., Medical Achievement Awards, in recognition of his contributions to the understanding of sickle cell anemia through his research on the structure of the hemoglobin molecule.

Dr. Kenneth M. Endicott, Director of the Bureau of Health Manpower Education, and former Director of the National Cancer Institute, received a special award for cancer research from the American Association for Cancer Research, noteworthy because it was only the seventh time in the Association's 63-year history that the award has been presented.

NIH was elected to receive the Edward R. Loveland Award presented by the Board of Regents of the American College of Physicians, in recognition of "distinguished contributions in the health field." Dr. Robert Q. Marston, Director of NIH, accepted the award at the ACP Convocation in Atlantic City.

Appointments

Dr. Frank J. Rauscher, Jr., was named Director of the National Cancer Institute and charged with responsibility for carrying out an expanded, intensified, and coordinated cancer research program. Dr. Rauscher was formerly NCI Scientific Director for Etiology.

Dr. Rudolph Ellsworth Jackson, a specialist in blood disease at St. Jude's Childrens Research Hospital, Memphis, and a faculty member of the University of Tennessee College of Medicine, was appointed to coordinate DHEW sickle cell activities and serve as Chief of the Sickle Cell Disease Branch in the National Heart and Lung Institute.

Facilities and Organization

In October of last year, President Nixon announced that Fort Detrick's laboratories and facilities would be converted into a cancer research center. With laboratories designed and equipped to work with the most hazardous agents at minimum risk to the scientist, Fort Detrick is uniquely suited for studies involving highly concentrated and purified viral isolates and viral nucleic acids. In

June of this year, it was announced that Litton Bionetics, Inc., of Bethesda, Maryland, would manage, renovate and operate NCI's Frederick Cancer Research Center at Fort Detrick. The $6.8 million contract for the first year was the largest ever awarded by an NIH Institute.

Under Public Law 92–305 the National Institute of Arthritis and Metabolic Diseases was redesignated as the National Institute of Arthritis, Metabolism, and Digestive Diseases (NIAMDD). The change more adequately reflects the Institute's interest in digestive diseases and renewed emphasis in this group of disorders which chronically affect about 13 million Americans and are the primary cause of hospitalization.

Administration of the Middle America Research Unit in the Panama Canal Zone was transferred from the National Institute of Allergy and Infectious Diseases to the Gorgas Memorial Institute of Tropical and Preventive Medicine, Inc., of Washington, D. C. NIAID had directed the research efforts of MARU since its establishment in 1957. To permit the orderly termination of present research, collation and publication of research data and disposition of scientifically valuable serological specimens, final departure of some NIAID professional staff was deferred for a year.

The Division of Biologics Standards was transferred from NIH to the Food and Drug Administration, and renamed the Bureau of Biologics. The Division has Federal responsibility for regulation of serums, blood and blood products, vaccines and other biologics, and conducts necessary research to support this activity.

Research Advances

Advances were made during the year in both basic and clinical research.

Two National Institute of Child Health and Human Development scientists, Dr. Erhard Gross, head of the Section on Molecular Structure in the Laboratory of Biomedical Sciences, and John L. Morell, also in LBS, described for the first time the chemical structure of nisin, a polypeptide antibiotic produced by *Streptococcus lactis*, a common microorganism, finding several unique structural features. On the basis of their findings anti-malarial and membrane activity was postulated.

An NIH grantee, Dr. William W. L. Glenn, and a team of doctors working in the DRR-supported Clinical Research Center at the Yale University Medical School, successfully utilized a newly-designed radiofrequency technique that enabled a victim of a racing-car accident to resume activities as near normal as his respiratory disability would allow. Two miniature receivers, implanted in the subcutaneous tissue on the anterior chest wall, electrically stimulate the phrenic nerves upon receipt of impulses from a small radio transmitter carried in the pocket.

The complete amino acid sequence of the first six known protein compounds of lipoproteins, the transport vehicles for most of the fatty substances (lipids) in human blood, was worked out by Drs. Bryan Brewer, Jr., Richard S. Shulman, Peter Herbert, and Rosemary Ronan and Katherine Wehrly of the National Heart and Lung Institute. Their work may stimulate medical understanding of lipoprotein function and metabolism and of the role these lipid-transport particles play in the genesis of atherosclerosis.

Technical development of an atomic-powered heart-assist system progressed to animal testing. A complete heart-assist system was implanted in a calf to initiate biological assessment of the plutonium-powered engine and pump. The device was designed by Dr. Lowell Harmison, acting chief, Medical Devices Applications Branch, National Heart and Lung Institute and developed by contractors under the direction of NHLI.

National Cancer Institute

A New National Program

In Fiscal Year 1972, the annual appropriation of the National Cancer Institute rose to $377,531,000, the highest Congressional appropriation for cancer in the Institute's history. This level was attained through an original appropriation by the Congress of $237,531,000, plus a special appropriation of $100 million requested by the President for 1972 and 1973, and an additional $40 million provided for construction of cancer research facilities and training of cancer scientists.

The same year that produced this increase of more than $147 million over the previous appropriation also saw The National Cancer Act of 1971 signed into law by the President on December 23.

The Act authorized the Director of the National Cancer Institute, located within the National Institutes of Health, to: 1) plan and develop an expanded, intensified, and coordinated cancer research program encompassing the programs of the Institute, related programs of the other research institutes, and other Federal and non-Federal programs, with the advice of the National Cancer Advisory Board; 2) utilize existing research facilities and personnel of NIH for accelerated exploration of opportunities in areas of special promise; 3) encourage and coordinate cancer research by industrial concerns which evidence a capability for such research; and 4) collect, analyze, and disseminate all data useful in the prevention, diagnosis, and treatment of cancer, including the establishment of an international cancer research data bank.

The Act also authorized the establishment of 15 new centers for clinical research, training, and demonstration of advanced diagnostic and treatment methods related to cancer. For the planning, establishment, strengthening, and basic operating support of existing or new centers, cooperative agreements with public and private nonprofit agencies were also authorized. Cancer control programs are to be established as necessary for cooperation with State and other health agencies in the diagnosis, prevention, and treatment of cancer.

Additionally, the Act provided that: 1) the Directors of the National Institutes of Health and of the National Cancer Institute are to be appointed by the President; 2) a three-member Cancer Panel, to be appointed by the President, will monitor the national cancer program and report directly to the President; 3) the President will receive from the Director of the National Cancer Institute a scientific review of the program each year and a plan for the program during the next five years; 4) the President will carry out and submit to Congress an administrative review within one year of the legislation's enactment with recommendations for any needed legislative changes; 5) the budget of the National Cancer Institute will go directly from the Institute Director to the President with opportunity for comment, but not change, by the Secretary of the Department of Health, Education, and Welfare, the Director of the National Institutes of Health, and the National Cancer Advisory Board. Appropriated funds will go directly from the President and the Office of Management and Budget to the National Cancer Institute.

The Act established the National Cancer Advisory Board, composed of 23 members—18 appointed by the President—not more than 12 of whom may be scientists and physicians. Also on the Board are five Federal officials, who serve *ex officio*. The President's Cancer Panel makes periodic progress reports directly to the President. At least two members must be distinguished scientists or physicians. It meets at the call of the chairman but not less than 12 times a year.

Dr. Frank J. Rauscher, Jr., formerly Scientific Director for Etiology, was appointed Director of the Institute by President Nixon on May 5, 1972.

On October 18, 1971 the President announced that the Army's Biological Defense Research Center at Fort Detrick, Maryland, would be converted into a leading center for cancer research as part of the campaign to conquer cancer. Later, on June 23, 1972, Litton Bionetics, Inc., a subsidiary of Litton Industries, Inc., was awarded a research contract for a $6,850,000 first-year program to renovate, manage, and operate the cancer research facility at Fort Detrick.

Meanwhile, a plan was under development in FY 1972 for the establishment of bureau-level organization for the National Cancer Institute. The plan called for the achievement of several objectives: (a) it would give the NCI and its components an organizational status commensurate with the responsibilities given to the Institute by The National Cancer Act of 1971; (b) it would establish an organizational framework for coordinating the expanded responsibilities and programs of the NCI; and (c) it would establish an organizational structure relating directly to the objectives of the developing National Cancer Program Plan.

In order that optimal progress toward control of cancer might be assured, steps were taken by the NCI beginning in October 1971 to formulate and implement a National Cancer Program Plan. To involve leaders of relevant segments of the scientific community at every stage of the Plan's development, a series of meetings involving about 250 scientists addressed itself to formulation of scientific approaches to 7 specific program objectives. Forty-one interdisciplinary groups analyzed these approaches in greater depth and recommended 764 detailed project areas designed to implement them. The resources required to carry out the program were also estimated. Recommendations emerging from the advisory groups will be translated into the expanded, intensified and coordinated cancer research program called for in the National Cancer Act of 1971.

Viruses and Cancer

In December 1971, scientific teams working independently in the Washington, D. C. area and in Los Angeles, both cooperating in NCI's Special Virus Cancer Program, each reported what they believe to be a candidate human cancer virus. The discoveries were announced at the Children's Hospital of Los Angeles and Georgetown University Medical Center. Both groups found the postulated cancer-causing virus, which may be the same, in rhabdomyosarcoma, the cancer of skeletal muscle. Efforts are in progress, or planned, to determine whether these viruses are indeed of human origin, whether they occur primarily in human cells, and whether they are capable of causing cancer in animals.

During the year, Dr. Padman S. Sarma, an NCI scientist, produced evidence that some cancer-causing viruses of the cat occur in nature as mixed strains rather than pure strains. If virus strains prove to be mixed in man, this may explain, for example, why some influenza vaccines are not totally effective when designed against pure strains.

Four NCI scientists, Drs. Edward M. Scolnick, George J. Todaro, Stuart A. Aaronson, and Wade P. Parks, discovered that three new RNA viruses which may cause cancer in primates differ immunologically from similar RNA viruses found in the mouse, rat, hamster, and cat. The investigators suggested that the distinction may provide clues that will aid in the search for a viral cause of human cancer. The three primate viruses were found in muscle cancers of a seven-year-old child and a woolly monkey and from a lymph cancer of the gibbon ape.

Evidence suggesting a possible link between viral hepatitis infection and the development of primary liver cancer was presented by an NCI scientist working in Uganda. His findings were based on a continuing study of 120 patients with primary liver cancer.

Cancer Treatment

The long-term survival rate of patients with Burkitt's lymphoma, a rare form of cancer of the lymph system, has tripled in the last four years, according to an NCI physician working in Uganda, after study of more than 130 patients with this cancer. The long-term survival rate jumped from 20 percent to over 60 percent due to the dramatic response of the disease to drug therapy, particularly to the use of the drug cyclophosphamide.

An NCI radiotherapist reported that more than 95 percent of a group of patients with Hodgkin's disease diagnosed at an early stage have survived for at least five years after preventive radiation treatment. His findings were based on a seven-year study of 164 patients by the Institute's Radiation Branch.

Of 43 patients with advanced Hodgkin's disease, 43 were reported alive with no apparent sign of disease four to seven years after the start of treatment with a four-drug combination, according to a team of Institute chemotherapy specialists.

A new method of classifying the stages of Hodgkin's disease was developed by an NCI investigator and colleagues to assist physicians in choosing the most effective therapy for patients with this cancer of the lymph system. "Staging," a system of describing the extent of the disease, provides information needed to determine the optimum type of therapy for any given patient. The new procedure is based on two systems of classification—clinical and pathological—rather than the clinical system used since 1965.

A Japanese guest worker at NCI reported that adriamycin, a relatively new antibiotic active against a wide range of human cancers, was more effective against leukemia in mice when used in combination with a second anticancer drug, methotrexate, than when used alone.

The Scientific Director for Chemotherapy flew to Moscow on June 25, 1972 to sign an agreement on Joint U.S.–U.S.S.R. research on anticancer drugs with the Director, Institute of Experimental and Clinical Oncology, U.S.S.R. Academy of Medical Sciences. The meeting of the team of U.S. and Soviet scientists June 25–30 was held under the health agreement announced by President Nixon and the Soviet Minister of Health in February.

During the year the National Cancer Institute opened liaison offices in Japan and Belgium to foster greater international cooperation in the development and use of anticancer drugs. Both offices are to operate under research contracts.

Detection and Diagnosis

A project to evaluate an early detection test developed for cancer of the colon and rectum was initiated under a contract awarded to the Tufts University School of Medicine. Tufts investigators will examine the specificity of a test developed earlier by Dr. Phil Gold of McGill University, Canada.

An NCI-supported project to improve survival of lung cancer patients by applying early detection methods was begun at the Mayo Clinic, Rochester, Minnesota, as companion to a study funded by the Institute at Johns Hopkins University to improve the diagnosis of lung cancer. The investigations involve chest X-rays and microscopic examinations of cells obtained from deep cough sputum samples.

Chemicals and Cancer

The cancer-causing effect of environmental chemicals in combination with other chemicals is under study by scientists at the Stanford Research Institute, Menlo Park, California, under a contract awarded by NCI. The known cancer-causing effect of single chemicals will be compared with their ability to cause cancer when combined with other chemcials. Researchers hope to identify chemicals that inhibit the carcinogenic effect of other chemicals as well as those that increase it. The Stanford Research Institute also holds an NCI contract for a special study to improve the efficiency of research for the identification of carcinogens in the human environment.

NCI-supported investigators of the Southwest Research Institute, San Antonio, Texas, announced that they had identified a type of cancer-causing chemical called N-nitrosamines in cigarette smoke condensate. This study is part of an effort to complete the profile of chemical constituents of cigarette smoke condensate, so that cancer-inducing substances can be identified and eliminated.

A fourth volume in the series, "Survey of Compounds Which Have Been Tested for Carcinogenic Activity," was published during the year. The new publication, prepared under an NCI contract, includes reports for the years 1968 and 1969.

Immunology and Cancer

An NCI investigator reported that some virus-caused cancers in mice can be prevented by reinforcing the animal's defective immune system with anti-lymphocyte serum. Observations from these studies, though not yet thoroughly understood, increase the possibilities for immunologic therapy in human cancer.

Antibody was developed against the principal internal protein of four RNA cancer viruses of animals. Working under NCI contract, scientists at Flow Laboratories, Rockville, Maryland, successfully developed immunologic reagents, specific antibody-containing substances, that recognize leukemia viruses of four species of mammals. This work provides an important tool for eventually detecting the long-sought human cancer viruses.

Contrary to previously held belief, impairment of the immune system of a Hodgkin's disease patient, as measured by several tests, does not adversely affect his chance of surviving if he receives appropriate treatment for this cancer of the lymph system, it was suggested by a team of NCI investigators. In earlier studies, a number of scientists found what they believed to be a correlation between length of survival and a patient's response to immunologic tests that measure reactions to foreign substances.

Two groups of NCI scientists presented evidence suggesting that leukemia cells contain specific antigens that make those cells distinguishable from normal cells. Establishing the presence of these antigens is an important step in developing therapy based on principles of immunology as well as detection methods. Such antigens may indicate that an individual has early, presymptomatic leukemia or that he has been exposed to the causative agent, possibly a virus, and may later develop the disease. These antigens thus may also serve as a marker for the causative agent.

Demography

Preliminary reports of a study of cancer incidence covering eight large metropolitan areas and one entire state made in 1969 by NCI's Biometry Branch, indicated that: (1) the overall incidence of cancer in men is increasing, a trend particularly marked among blacks, while in women it is decreasing; (2) the incidence of lung cancer has doubled in both men and women of both races; (3) the incidence of cancer in blacks is substantially higher than in whites, a difference particularly large between black and white men. The study is part of the Third National Cancer Survey, a sequel to the Ten Cities Surveys of 1937 and 1947 on cancer in ten large cities and surrounding areas.

An NCI team of biometrists and others showed that statistical methods applied to factors which affect survival in Hodgkin's disease may help to predict the length of survival of a person with this form of cancer. Knowledge of the factors affecting survival helps physicians plan X-ray and drug treatment for their patients.

National Eye Institute

Research supported and conducted by the National Eye Institute is directed toward improving our ability to prevent, diagnose, and treat blinding and disabling eye diseases. Progress toward this goal was made during 1972 in both laboratory and clinic under the Institute's expanding program to develop new knowledge and spur application of these findings to reducing visual disability.

Particular research emphasis during the year was placed on glaucoma and retinal disease, disorders which account for over 40 percent of all blindness in the United States.

Glaucoma

Glaucoma, an eye disease which strikes one out of every 200 people in the United States over age 40, is the target of enlarged and intensified research launched during the year. The Institute selected glaucoma for emphasis because a considerable amount of knowledge already exists—the result of decades of research—which is ready to be applied for the benefit of glaucoma patients. In particular, the program is directed toward improving methods of early detection, developing new drugs and surgical techniques, and exploring the possibility of reversing the early loss of visual function.

To help formulate plans for a national program, the Institute convened a task force of experts in glaucoma research. After these scientists presented their recommendations, the Institute awarded the first nine in a series of contracts intended to foster progress within the next five years.

Under one contract, an investigator at Washington University in St. Louis is investigating whether the drug diphenylhydantoin, commonly used to control neurologic seizures, can restore early loss of visual function in glaucoma. Until recently, visual loss has been considered irreversible. Preliminary evidence indicates that the drug can help.

Meanwhile, ongoing research yielded additional information. Although the cause of the most common form of glaucoma is unknown, loss of visual function in this disease is preceded by a rise in the normal pressure within the eye resulting from a blockage in the circulation of fluid through the front portion of the eye. NEI grantees at George Washington University have demonstrated that the blood circulation in the eyes of experimental animals is very sensitive to variations in the intraocular pressure.

Their research is now being directed toward understanding of how this effect occurs, its implication in the development of glaucoma, and its response to drugs and surgery.

In the Institute's own clinic, NEI Director Dr. Carl Kupfer is investigating the causes of congenital glaucoma, a severe form of the disease which can blind infants and children before it is recognized. Dr. Kupfer's research has indicated that some cases of congenital glaucoma may be caused by failure of the tiny outflow channels that drain fluid from the eye to develop normally. If research bears this out, improved surgical correction may be possible.

Retinal Diseases

Diseases of the retina, the light-sensitive tissue at the back of the eye that transmits visual information to the brain, account for more blindness and visual disability in the United States than any other cause. Diabetic retinopathy, an ocular complication of diabetes, retinal detachment, and retinitis pigmentosa, an inherited disease causing progressive visual loss in children and young adults, are among the significant conditions.

After a year of planning, the NEI grant-supported Cooperative Diabetic Retinopathy Study began enrolling patients in an anticipated ten-year evaluation of the treatment of this disease by photocoagulation. This therapy involves focusing of an intense beam of light onto the retina to weld bleeding blood vessels.

This carefully designed and controlled clinical trial, which will eventually involve 16 research centers and 1800 patients, is aimed at determining the value of photocoagulation in preserving vision. It is also expected to yield important new information on the disease itself.

Although the outlook for surgery in uncomplicated retinal detachment has improved considerably in recent years, many types of retinal detachment are too complex to be repaired by conventional procedures. A new surgical instrument, developed with NEI support by investigators at the University of Miami, appears capable of simplifying and extending the range of treatment. It may be useful in complicated retinal detachment as well as diseases of the vitreous, the transparent gel filling the center of the eye, and also may be of great value in removing vitreous opacities and in repairing large retinal detachments, both of which may result from diabetic retinopathy.

NEI-supported investigators at UCLA are studying a strain of rats with a hereditary retinal disorder that appears to be similar to human retinitis pigmentosa. They have found that a breakdown occurs in the normal life cycle of the photoreceptor cells in the retinas of these animals, a discovery which may be of great importance in understanding the basis of human retinitis pigmentosa.

Population Studies

The Institute's Office of Biometry and Epidemiology began a contract-supported study of eye disease in a Framingham, Massachusetts, population group which was the subject of a 20-year investigation of heart disease risk factors conducted by the NIH National Heart and Lung Institute. The NEI investigation is to identify individuals who have one of the four most common causes of adult visual disability—cataract, senile macular degeneration, chronic simple glaucoma, and diabetic retinopathy. In addition to measuring the prevalence of the diseases, the Institute hopes to identify risk factors associated with eye diseases, an accomplishment which would significantly aid in prevention.

National Heart and Lung Institute

Extramural Research and Training

The complexities of the problems posed by the cardiopulmonary diseases dictate research programs of great scope and diversity. The backbone of the Institute's research effort is its regular research grants program. During Fiscal Year 1972 this program supported 1,471 grants totalling $106,349,000 in the following areas: arteriosclerosis, coronary heart diseases, congenital and rheumatic heart disease, heart failure, shock, respiratory diseases, hypertension, and thrombosis and hemorrhagic diseases.

The Institute also supported the establishment of eight additional Specialized Centers of Research (SCORs), bringing to 42 the number established since the inception of this program in 1971. Allocations totalled $20,584,000 during FY 1972. Fifteen SCORs deal with arteriosclerosis, 17 with pulmonary disease, 5 with hypertension and 5 with thrombosis. Each center is attacking a limited number of high-priority problems. SCOR activities are coordinated by NHLI, which also encourages cooperation among the centers to facilitate rapid dissemination of new knowledge and prompt evaluation of promising new approaches to prevention and therapy.

During the year NHLI supported 373 training grants and 306 fellowship and career development awards to (1) expand and improve training provided to medical students and (2) support advanced training of graduates seeking research, teaching, or clinical careers in the cardiopulmonary field. The Institute also awarded 12 new Pulmonary Academic Awards to schools of medicine to help meet present needs for highly trained manpower in pulmonary physiology and lung disease. The total outlay for these training activities was $24.9 million.

Collaborative Research and Development

The Collaborative Research and Development Program provides research contracts for highly targeted studies which complement, but do not duplicate, projects supported under regular research grants.

The Lipid Metabolism Branch, established during 1971, provided $5,380,000 in support of 12 Lipid Research Clinics at medical centers around the country. Research at these clinics is designed to improve the detection and clinical management of blood-lipid abnormalities. Elevated blood levels of cholesterol and other fatty substances (collectively called lipids) are often strongly associated with increased risk of premature arteriosclerosis and coronary heart disease. Specifically, studies seek to (1) ascertain the prevalance of various blood-lipid abnormalities; (2) assess the risk of atherosclerosis associated with each type; and (3) evaluate the effectiveness of therapeutic diets and lipid-lowering drugs in reducing illness and death from atherosclerosis and coronary heart disease among those afflicted.

The Myocardial Infarction Branch awarded 46 contracts totalling $8,019,341 for research directed toward reduction of death and disability from acute heart attacks and their complications. This included continued support of 9 Myocardial Infarction Research Units (MIRUs). These units combine excellent patient care with intensive research to develop new clinical knowledge and to devise improved methods of diagnosis, monitoring, and treatment that will be widely applicable.

Coronary heart disease is believed to be responsible for some 400,000 sudden deaths each year. Many of these deaths occur within seconds or minutes of the onset of symptoms. The MI Branch is currently supporting studies to (1) identify factors increasing risk of sudden cardiac death; (2) identify premonitory signs or symptoms that might give advance warning of an impending episode; (3) identify factors that "trigger" potentially fatal episodes in patients with coronary heart disease; and (4) develop practical methods of treatment for the very early stages of acute heart attacks.

A large number of sudden cardiac deaths are thought to stem from heart rhythm abnormalities that progress quickly and unexpectedly to cardiac arrest. The Branch is supporting studies on the electrical properties of the heart and on metabolic derangements possibly underlying the development of potentially fatal arrhythmias. The studies are also evaluating available drugs for arrhythmia prevention and control.

The Medical Devices Applications Program supported 57 contracts totalling $10,572,519 for research and development aimed at reducing death and disability from cardiovascular and respiratory diseases. Principal areas included (1) development of materials compatible with blood and other bodily tissues; (2) development of a family of devices to assist the failing heart or to replace the irreversibly damaged heart; (3) development of devices for monitoring and treating patients with acute or chronic lung diseases; and (4) preclinical and clinical evaluation of devices and instrumentation emerging from the program. Significant developments reported during the year include:

- A capillary membrane oxygenator that has been successfully tested clinically in patients undergoing open-heart surgery under heart-lung bypass.
- An atomic-powered circulatory-support system that is completely implantable and, in theory at least, should be capable of providing reliable circulatory assistance for 10 years or more. The device is presently undergoing experimental evaluation in animals.

The Sickle Cell Disease Branch, established during the past year, was assigned responsibility for coordinating the efforts of NHLI and other Institutes of NIH, HSMHA, and other Federal agencies in a greatly expanded program of research, training, community services, and information on sickle cell anemia. During the past year, the National Sickle Cell Disease Program awarded grants and contracts totalling $9 million in support of the following activities:

- Establishment of Comprehensive Research and Community Service Centers to bridge the gap between fundamental research, clinical application, and community service.
- Support of fundamental and applied research on sickle cell anemia and evaluation of promising new forms of therapy for sickle cell crises.
- Establishment of Screening and Education Clinics in communities to provide information, screening and definitive diagnosis of sickle cell disease, and referral of patients to appropriate sources of therapy and followup care.

The National Blood Resource Program awarded 60 contracts totalling $5,368,392. Research was continued to develop (1) improved methods of fractionating blood into its components; (2) diagnostic techniques for prenatal detection of hemophilia and certain other hereditary blood disorders; (3) improved means for the detection and prevention of hepatitis transmission through blood or blood products; and (4) definitive knowledge about current blood banking practices and problems.

New studies included (1) research to determine the incidence and mode of transmission of cytomegalovirus infections among transfused recipients; (2) epidemiological studies of human carriers of the hepatitis-associated antigen; and (3) trials to determine the effectiveness of gammaglobulin rich in antibody to the hepatitis-associated antigen in prevention or treatment of transfusion-associated hepatitis.

The Respiratory Diseases Branch is supporting 20 contracts totalling $1,505,000 for studies in the following areas:

- Development of techniques for the earliest possible detection of chronic obstructive lung disease prior to the development of overt symptoms. Recent research indicates that such diseases may first become manifest in the smallest airways and may produce detectable changes in lung function long before providing noticeable symptoms. The results suggest that, if detected at this early stage, the disease process may be reversible.
- Epidemiological studies in human populations and laboratory studies employing animal models to determine the relation of cigarette smoking to development of chronic obstructive lung disease.
- Studies of environmental and genetic factors that may identify individuals at high risk of developing chronic obstructive lung disease. One factor under intensive study is a hereditary deficiency of the enzyme alpha-1-antitrypsin, which appears to make affected individuals highly susceptible to the harmful effects of cigarette smoking or exposure to other lung irritants.
- Studies on oxygen therapy and other forms of respiratory assistance in chronic obstructive lung disease, including detailed studies on the mechanisms of oxygen toxicity.

The Clinical Applications Program is supporting studies to test the validity of the Risk Factor Hypothesis in relation to premature morbidity and mortality from atherosclerosis and coronary heart disease. Through experiments in laboratory animals and epidemiological studies in human populations, much has been learned about factors that increase susceptibility to premature coronary heart disease. For example, a person who has elevated blood-lipid levels, or who has high blood pressure, or who smokes cigarettes, is much more likely to develop coronary heart disease and its complications than is someone who does not have any of these risk factors. If several risk factors are present in the same person his susceptibility may be more than 10 times as high as that of the person with none.

A study is underway to evaluate effectiveness of countermeasures against three major risk factors—elevated blood lipids, hypertension, and cigarette smoking—in reducing illness and death from cardiovascular disease.

Intramural Research

The 10 Laboratories and Branches of the NHLI Intramural Research Program conduct basic and clinical studies on the cardiopulmonary system and the diseases that afflict it. Findings reported during the year include:

- Kallikrein, an enzyme that controls production of bradykinin, a powerful blood-vessel dilator, may be a factor both in essential and secondary forms of hypertension. NHLI studies showed that urinary levels of kallikrein in patients with essential hypertension were only about half those found in normotensives. Kallikrein levels in patients with hypertension secondary to renal artery obstruction or hyperaldosteronism were about twice normal. This suggests that kallikrein may be a factor in both forms of the disease and may provide a means of differentiating among the various forms of hypertension.

- Type II hyperlipoproteinemia, characterized by excessive blood cholesterol levels, is one of the most common and most dangerous of the blood lipid abnormalities, and is often associated with premature coronary heart disease. Recent NHLI findings indicate that Type II is often hereditary, can be expected in about 50% of the offspring when either parent is a hereditary Type II, and can often be detected by lipoprotein analysis of cord blood samples from threatened infants. It is hoped that the earliest detection and prompt treatment of Type II will substantially reduce the threat of premature atherosclerosis among those afflicted.

National Institute of Allergy and Infectious Diseases

Immunology is the basic scientific discipline which seems to hold the key to control of both allergic and infectious diseases. Impressive advances have been made in recent years in unravelling the complex cellular interactions which underlie the immune response. This knowledge is being applied to the diagnosis, management, and therapy of numerous diseases and immunologic derangements.

Allergy

Last year NIAID initiated an Allergic Disease Centers Program with the award of grants to seven institutions. During the past Fiscal Year, two more Centers were established. Program directors and senior staff of the first seven Centers met in December to report progress and plans of their programs.

Several themes were recurrent, including the causal relationship of infections to asthma, non-allergic mechanisms producing asthma and other immunologic derangements, and the allergic response as characterized by a special blood protein—IgE.

In research on immunologic diseases, NIAID clinicians reported the successful drug treatment of hereditary angioneurotic edema (HANE). The drug Epsilon Amino Caproic Acid (EACA) was evaluated in 5 patients—all of whom had severe illness and showed the characteristic lack of a protein which acts as an inhibitor of many inflammatory systems within the body.

In a carefully controlled study, Institute physicians found that EACA is an effective therapeutic agent for HANE. They noted some toxic side effects of the drug but reported that the patients are being maintained on low doses and continue to do well.

Influenza

With advice from a special committee of experts, the Institute last year held the first three of a series of workshops on influenza. Scientists attending these meetings addressed themselves to the problem of controlling a possible influenza pandemic in the late 1970's and made recommendations regarding research on the antigenic structure of the influenza virus, immunologic methodology, and vaccine development.

For years, influenza has posed special problems in disease prevention because of the influenza virus' uncanny ability to change its structure. These periodic changes, known as antigenic shifts, render past vaccines useless and leave entire population groups susceptible.

No one knows for sure why these shifts occur but it has been suggested that, in nature, animal and human influenza viruses somehow combine. Taking a cue from nature, an Institute grantee propsed several years ago that if two or more influenza viruses, each bearing a desired trait, were deliberately mated, vaccines could be "tailor-made" to meet antigenic shifts.

Such a vaccine, known as X–31, was tested during the past year by NIAID in cooperation with the Army. In a large group of military trainees the killed X–31 afforded a degree of protection against influenza comparable with that of earlier vaccines. The feasibility of using the recombination technique for vaccine production was thus demonstrated.

More recently, NIAID scientists put this laboratory trick (virus mating) together with another (gene alteration, or mutation) and developed a *live* temperature-sensitive recombinant vaccine. To produce the new vaccine, the investigators took a live temperature-sensitive mutant of an old strain and combined it with the more recent Hong Kong virus. Because of the genetically determined temperature sensitivity of the mutant, the recombinant strain, when tested in volunteers, set up a vaccine infection only in the cooler areas of the upper respiratory tract and not in the delicate warmer lung tissues. The vaccine was protective against challenge with natural Hong Kong virus, was genetically stable, and did not spread from those who had been vaccinated to unprotected contacts living in close quarters.

Hepatitis

Another infectious disease of important concern to NIAID is hepatitis. The Institute's Collaborative Program has as one of its long-range goals research leading to control of both forms of the disease: hepatitis A (infectious) and hepatitis B (serum). Emphasis, however, is being placed on hepatitis B, since recent knowledge of hepatitis B antigen (Australia antigen) and antibody facilitates study of this disease.

Substantial progress was made in the development of subhuman primates as animal models. An Institute scientist, in collaboration with other NIH investigators, successfully transmitted hepatitis B to rhesus monkeys. Although the infected monkeys failed to develop clinical or subclinical hepatitis, evidence of infection was indicated by the appearance of hepatitis B antigen and subsequent development of antibody.

Venereal Disease

The Institute has established a special emphasis research program on the basic biology of venereal disease. This represents a new and broadened initiative growing out of two workshops organized by the Institute. The first meeting explored the problem areas of the gonococcus and the current epidemic of gonorrhea. The second workshop explored important aspects of syphilis and its causative agent. Response to the new initiative was positive with new applications for research grants in venereal disease continually being received.

MARU

A loss to the intramural program during the year was the disestablishment of the Middle America Research Unit, located in the Panama Canal Zone. Due to difficulties in staffing, administration of MARU was transferred, under contract, to Gorgas Memorial Institute of Tropical and Preventive Medicine. Under terms of the contract, the MARU organization will continue its research efforts and final departure of some NIAID professional staff will be deferred for a year. This permits the orderly termination of present research programs, the collation and publication of data, and disposition of scientifically valuable serological specimens.

U.S.-Japan Program

During the past year a new area of research interest was defined by members of the United States-Japan Cooperative Medical Science Committee. A new panel will encourage research on methods for evaluating environmental mutagenesis and carcinogenesis. Plans have been made for a scientific meeting focusing on environmental diseases. Since 1968, day-to-day operation of the United States portion of the U.S.-Japan Program has been the responsibility of the Geographic Medicine Branch of NIAID.

National Institute of Arthritis, Metabolism, and Digestive Diseases

During Fiscal Year 1972 the National Institute of Arthritis and Metabolic Diseases, by legislative action, became the National Institute of Arthritis, Metabolism, and Digestive Diseases. The name change reflects more adequately the Institute's interest in digestive diseases and renewed emphasis on this group of disorders which affect about 13 million Americans, and which represent the number one cause of hospitalization in this country.

Arthritis

A principal effort in arthritis research revolves around the possibility that rheumatoid arthritis may be the result of an autoimmune reaction, perhaps triggered by an as yet uncharacterized infection, in which the body overreacts to proteins originating within its own tissues. It is therefore of interest that a rheumatoid arthritis-like disease has been produced in pigs by injecting them with certain mycoplasma organisms. Such studies may shed light on the cause and natural history of human rheumatoid arthritis.

Other investigations have revealed that prolonged treatment of rheumatoid arthritis with the immunosuppressive drugs cyclophosphamide or azathioprine can be beneficial in selected patients who do not respond to conventional therapy, despite the toxicity of these drugs. It was also found that passive joint exercise significantly increases inflammation in joints affected with acute arthritis. This is the first clinical evidence to support the long-held theory that acutely affected joints should receive complete local rest.

Diabetes

Recent diabetes research has focused upon ways of suppressing or postponing the development of complications such as enhanced atherosclerosis and consequent coronary heart disease, nerve damage, kidney failure, and blindness. During the year, long-term studies revealed that another well-known antidiabetic drug, phenformin, like tolbutamide, is apparently no more effective than diet, or diet and insulin, in prolonging the life of patients with mild, adult-onset diabetes. Phenformin therapy also was associated with a higher than normal death rate from heart disease.

Although these findings cannot be regarded as definitive proof of adverse effects, they raise questions concerning the long-term benefits of tolbutamide and phenformin therapy, and even concerning the importance of strict regulation of blood sugar levels, heretofore considered an important therapeutic goal, in providing longevity for patients with adult-onset diabetes.

In the continuing search for better therapeutic measures, improved diabetic control has been observed in diabetic rats following transplantation of insulin-producing pancreatic beta cells from inbred rats of the same strain. Such a procedure ultimately may prove superior to transplantation of the entire pancreas, which has been attempted a number of times in humans, with little success.

Digestive Diseases

The diversity and magnitude of digestive diseases, including peptic ulcer, ulcerative colitis, and disorders of the liver, gallbladder, and pancreas, place them among man's most frequent chronic and disabling afflictions. An Institute-funded study in Minnesota has resulted in the first instance of dissolution in man of cholesterol gallstones, following long-term oral administration of a naturally occurring bile acid, chenodeoxycholic acid. This early success has led to initiation of similar studies involving larger numbers of patients at several research centers.

The Institute also has launched an in-depth study of Crohn's disease, or regional enteritis, an inflammatory condition of the intestine. Nine large research centers are evaluating the therapeutic and prophylactic value of drug treatments. Prompt and effective treatment of this debilitating disease could be the difference between an incapacitated, helpless and dependent person, and a productive, self-supporting one.

Endocrinology

Endocrinology, the study of the internal glandular secretions of the body, is an immense biomedical field which directly pertains to important life functions, such as growth, metabolism, and reproduction. In the past year, the molecular structure and synthesis of a new hormone isolated from the brain was described. Tests in experimental animals revealed that this hormone stimulates release from the pituitary gland of luteinizing hormone, thereby inducing ovulation.

This important finding should lead to a greater understanding of human fertility and to development of new methods for its regulation. There is promise that the hormone also may become a useful tool in the veterinary field.

Other studies have led to the development of an accurate screening test for adrenal insufficiency which requires only one hour and may be used as an office procedure. Standard tests now in use may require 24 hours or more and usually involve hospitalization.

Artificial Kidney Program

The goal of simpler, more efficient and less costly artificial kidneys seems nearer with the development of a new blood "washing" system based on the use of chemical adsorbents, which are capable of sequestering and eliminating uremic wastes. A number of patients have been dialyzed successfully with a new machine, which utilizes only minute quantities of dialysate fluid. The need for large tanks and plumbing has been negated, as well as the need for costly pre-treatment of water used for dialysis; portable suitcase-sized artificial kidneys are in the offing. In addition, a new generation of "multiple point support" flat-plate dialyzers, is now produced commercially, and has reduced the time requirements of flat-plate dialysis substantially—a significant economic improvement.

Dermatology

It is estimated that more than 4 million Americans suffer from psoriasis, one of the most common single skin diseases. This disease, when severe, can cause extreme disfigurement and disability in all age groups. Recent research has shown that the affected skin of affected individuals contains less cyclic adenosine monophosphate, or cyclic AMP, than unaffected skin or the skin of a normal person. If it can be shown that this is the basic cause of the rapid cell turnover that marks psoriasis, there are several known drugs, including those used in the control of cancer, which possibly would elevate cyclic AMP levels and retard the disease process. Since these compounds can be very toxic, the Institute planned a screening program to identify potentially useful agents.

National Institute of Child Health and Human Development

Population, child health, and the problems of the mature and aging adult are issues of particular concern to this Institute. With the commitment of the President and the United States Congress to these problems, NICHD continued to grow during the year.

The work of NICHD is focused on the continuing process of growth and development—biologic and behavioral—from conception and prenatal development through infancy and childhood and on into maturation and aging.

Population Research

This country's population has increased 50 percent in the past 30 years and is expected to increase another 50 percent before the year 2000. The impact of population growth cannot be assessed without considering its effects on the health of children, families, and society as a whole.

At NICHD laboratories in Bethesda and through its extensive grants- and contracts program, the Institute supports population research in three principal areas: development of new and improved methods of contraception, study of the medical effects of contraceptives in use, and investigations of the social aspects of population.

NEW CONTRACEPTIVE METHODS

No available contraceptive technique is fully satisfactory. The Center for Population Research has as one of its goals the development of new, more effective and convenient contraceptives. A contract for a biologic testing facility to evaluate the contraceptive activity of new drugs and devices was awarded this year. This facility will also unify testing standards.

MEDICAL EFFECTS OF CURRENT BIRTH CONTROL METHODS

Past studies have suggested undesirable or adverse effects of available contraceptive methods. Scientists are now monitoring the incidence of cancers of the breast and cervix to determine if any correlation exists between contraceptive use and these diseases. A new collaborative study, in the developmental stage, aims to monitor the outcome of some 50,000 pregnancies. NICHD scientists hope to determine what effects, if any, the use of steroid contraceptives has on progeny. Clinical studies of metabolic processes of contraceptive users and studies of the physiologic effects of intrauterine devices in animals have already yielded valuable information.

POPULATION RESEARCH IN THE SOCIAL SCIENCES

Some of the most fascinating aspects of today's population studies are concerned with the ways social, economic, and psychological factors influence fertility. Research takes into account and examines individual, familial, institutional, and social processes influencing decisions relating to family size.

POPULATION RESEARCH CENTERS

NICHD has made a long-term commitment to support population research. The Institute is providing support for facilities and investigators in six Population Research Centers. These Centers serve to accelerate progress by providing pooled facilities to cooperating investigators, who have ready access to their associates and to elaborate computers, electron microscopes, and other equipment and services which are unavailable elsewhere.

Child Health

The goal of NICHD research is to provide the knowledge necessary for identification and treatment of conditions that prevent mothers from bearing healthy babies. Development of new information about infant care and nutrition and the design and improvement of techniques for preventing or ameliorating congenital abnormalities fall within the purview of Institute studies.

SUDDEN INFANT DEATH SYNDROME

The sudden infant death syndrome is the leading cause of death in infants after the first month of life, claiming the lives of three infants for every thousand live births. A number of epidemiologic studies have provided knowledge about "susceptible" infants and possible causative factors.

Institute scientists give high priority to studies of immaturity, prematurity, and intrauterine growth retardation, development of the immune defense system, and heart and lung function to determine how these relate to sudden infant death.

GROWTH AND DEVELOPMENT

One of the most crucial requisites for the growth and development process in children is adequate nutrition. A number of studies indicate that a pregnant woman whose diet is severely deficient in protein or calories runs increased risk of having children with a lower birth weight and mental impairment. Severe malnutrition in the mother during the last trimester of pregnancy and in the infant's first 6 to 12 months has been shown to decrease the number of brain cells. Although study of severe malnutrition has been emphasized, the effects of milder undernutrition, commonly found in the United States, are also being investigated. These studies indicate that nutritional insufficiency also affects the child's ability to withstand infection.

A gap in scientific knowledge has been in the understanding of adolescent change—particularly in factors which prepare the child for assumption of adult roles. Investigations have been planned to study adolescent nutrition, the biologic mechanisms triggering the onset of puberty, and the psychological transition from childhood to adulthood.

MENTAL RETARDATION

About three per cent of children born in the U.S. show some degree of mental retardation. The greatest hope for solving this tragedy lies in prevention.

Development of mental capacities is dependent partially upon a genetic blueprint. These genetic instructions, however irrevocable, are, nevertheless to a large degree subject to modification by the child's prenatal and postnatal environment. For example, living in poverty may be associated with mild mental retardation. Institute studies encompass all the forces working on the child—physical, biological, psychological, and social—in an effort to understand and prevent retardation.

Progress continues in detection and treatment of genetically created inborn errors of metabolism such as phenylketonuria and galactosemia. Amniocentesis, a prenatal diagnostic technique, continues to show increasing promise for detection of genetic errors which may result in mental retardation.

The creation of 12 mental retardation centers affiliated with universities or State schools for the retarded represents a multidisciplinary attempt to solve some of the complex problems of mental retardation. Research at these centers is determined by the interests and expertise of local scientists, who are encouraged to undertake innovative research as opportunities arise.

Adult Development and Aging

Important advances in knowledge of the aging process have been made in studies of the immunologic system—the body's defense against disease. Deterioration of this system explains the increased susceptibility of the elderly to infections such as pneumonia and possibly to cancer. Working with animal models, scientists have now learned that immune efficiency can be restored. This has been done in animals by transfer of immunologically active cells from young animals to the old animals. It is not yet possible in humans because of the rejection phenomenon.

One very important phase of aging in women is the menopause. For reasons still unknown, at the menopause the cells that produce female sex hormones cease to function. The menopause is unusual in that it is the only aging process that can be treated. Although the treatment, simple hormone replacement, has been in use for a number of years, a great deal about it remains unknown. In addition, the association of these hormones with serious side effects is in need of further clarification.

National Institute of Dental Research

Dental Caries

The National Caries Program, launched by the National Institute of Dental Research in FY 1971, has expanded to a full scale, national attack on tooth decay with a budget allocation in FY 1972 of $9,155,000—almost double that of the first year.

The scientific resources of industry, universities, and private research organizations have been enlisted. Significant progress is foreseen from pursuit of several promising leads. Already, for example, more is known about the mechanisms of bacterial attachment to the teeth: each of the various type of organism seems to employ its own device. One type of streptococcus (mutans), a cause of decay, grows well on any sugar. However, it requires the frequent presence of sucrose (table sugar) for manufacturing a sticky film of plaque which allows it to colonize on teeth. Incrimination of this strain produced a host of other clarifying developments.

New methods of culturing, developed under NIDR support, now permit routine recovery of about 80 percent of the organisms found in plaque. This compares with the 20 percent previously attainable. The microbial makeup of plaque was found to vary from individual to individual.

Promising antiseptics are being screened as aids in plaque control and caries prevention. Other methods of decay prevention undergoing tests include effective ways of applying fluoride to the tooth surface and the use of adhesive sealants to protect the chewing surfaces. Modifications of the diet are being explored. Nutritional research includes tests of chewing gum containing a phosphate to alter the caries-inducing effects of sweets, and evaluation of trace elements in soil and water as potential decay inhibitors.

Periodontal Disease

Periodontal (gum) disease affects an estimated 75 million Americans. It ranks as a major public health problem. Investigations by NIDR are highly diversified since causes are not well understood. Studies include the role of enzymes, such as collagenase, in the destruction of periodontal tissue, observations on bone metabolism, and explorations of immunological aspects. Research has disclosed a number of substances which inhibit bone erosion. Results suggest that studies of a recently discovered compound (2-thiophene-carboxylic acid) may lead to new pharmacological means for controlling bone metabolism.

Recent work also shows that decalcified cortical bone (the hard, close, outer bony shell) will trigger new bone formation in the same animal species. Such evidence offers promise for the development of techniques to replace bone in humans. In the final stage of periodontal disease, the supporting fibers and the alveolar (jaw) bone which anchors the teeth are destroyed, and loosened teeth eventually fall out.

In successful human and animal studies, two antibiotics, kanamycin sulfate and vancomycin, were shown to be useful to control severe cases of gingivitis, especially in handicapped persons who cannot brush their teeth.

Improved Restorations

One of the most significant research accomplishments in dental materials was the development of a new amalgam filling material which is stronger and less corrosive than earlier amalgams. Using knowledge developed by grantees from basic metallurgical studies, other scientists evolved a practical way of eliminating the weakest phase of amalgam. Exactly how many additional years this innovative modification may add to the serviceable life of amalgam fillings awaits the results of clinical tests.

For tooth replacements, transplants from brothers and sisters with closely matched tissues seem to be succeeding. Some researchers are finding that implants of certain ceramics (calcium aluminate) with a particular pore size promise to serve well as a tooth root, because jaw tissues grow into the pores and anchor the implant with no signs of irritation or rejection. A method for extracting teeth with a high-speed oscillating device may prove quicker and less damaging to adjacent tissues and less painful than traditional instruments.

In another development, methods were made available for bonding artificial teeth to plastic denture bases. This technological advance provides a simple and effective approach to achieve retention than does the usual practice of cutting grooves into the teeth and then using a relatively weak cement for bonding.

Oral-Facial Anomalies

Several efforts are under way to improve the rehabilitation of persons with cleft lip or palate, as well as to increase understanding of causative factors. Each year in the United States, approximately 7,000 babies are born with this defect. Study of the causes of facial clefts, especially in families with no history of the defect, has been approached by measuring the lengths of certain bones in the skull and the distances between them as seen in X-ray pictures of such parents and their children. Scientists found the measurements are consistent with a theory that parents who have less than normal tissue in the midline of the face can pass on these configurations to their children. Thus, when any unfavorable embryological development occurs, there is not quite enough tissue to enable the sides of the fetal face to fuse properly, and a cleft results.

Lead Poisoning

Dental studies contributed a new public health tool for determining areas within cities which have dangerously high levels of lead. Analysis of teeth shed by young children are more accurate than blood samples for indicating chronic or past exposure to lead, because this metal is permanently deposited in hard tissue but soon clears from blood.

National Institute of Environmental Health Sciences

Environmental Health Hazards

Alpha chloro-ether compounds are widely found in the chemical industry. Some of them are highly reactive alkylating agents. An NIEHS grantee, exploring the carcinogenic potential of certain alpha chloro-ethers, showed that rats exposed to them at low airborne levels develop nasal and pulmonary carcinomas. These studies will be continued to assess the human health implications.

Projects concerned with the effect of heavy metal salts on the host defense mechanism were undertaken. It was found that immune capability—a normal protective mechanism against infection was depressed after exposure to salts of lead, cadmium, arsenic, or mercury in the drinking water.

The toxicity of orally ingested NTA, a chelating agent used as a phosphate replacement in the manufacture of detergents, was studied. A hyperglycemic effect was observed in rats and characteristic vacuolar lesions were found in the renal proximal tubules of NTA-treated animals.

A study of the effects of household detergents was prompted by changes in product formulations. It was shown that some phosphate substitutes have severe corrosive properties on rabbit eyes, suggesting that accidental introduction to human eyes could produce impaired vision.

Research was begun to determine whether noise levels in functioning pediatric incubators are damaging, or potentially damaging, to the hearing mechanism. The effect on hearing of noise in combination with toxic drugs was also investigated.

A microwave exposure system with a well-defined, uniform field characteristic was developed, permitting accurate quantitative studies of the effects of microwave radiation on biological systems at a precise frequency.

Environmental Health Research

Methods have been developed and refined to assess the chemical nature of genetic damage. The most notable accomplishment was development and utilization of a new mutational assay system in mouse lymphoma cells. This led to identification of a drug, used extensively in Africa and South America, as being potently mutagenic to mammalian cells. This system should contribute to the identification of mutagenic hazards in the environment and improve understanding of the types of mutations that occur in somatic cells in mammals and the mechanisms by which they occur.

A lung perfusion apparatus whereby scientists can study the uptake and release of chemicals, pollutants, and drugs delivered to an isolated, perfused lung by blood or by inhalation was developed. It will now be possible to define more carefully the parameters influencing uptake, release, and interaction of chemicals in the lung.

The Institute continued to develop the opossum as a marsupial model system useful for investigation of a large variety of physiologic, pharmacologic, pathologic, and toxicologic mechanisms. Preliminary findings indicated that the animal may have unique value for studying mechanisms of carcinogenesis and endocrine development.

International Conferences

To facilite exchange of information between scientists investigating environmental health hazards, the NIEHS sponsored two conferences on industrial chemicals. The first was organized to assess the state of knowledge of polychlorinated biphenyls (PCBs) and their impact on human health. Participants included representatives of industry, control and regulatory agencies, as well as scientists working on the problem. Proceedings of the conference were published in the first experimental issue of the Institute's journal, *Environmental Health Perspectives*. In the second conference, 100 participants discussed phthalate esters.

Advisory Board

In April 1972, the NIEHS established a Board of Scientific Counselors to provide expert advice on matters of scientific program policy, particularly from a long-range viewpoint, related to intramural research programs of the Institute. Members of the Board are leaders in the basic and clinical sciences related to the research activities of the NIEHS.

National Institute of General Medical Sciences

Genetic Disease Program

Support for research and training in genetics continued to be emphasized, furthering the Nation's capabilities to diagnose, prevent, treat, and cure human inherited diseases. Expenditures for research ($30.5 million) and for training grants and fellowships ($7.5 million) amounted to more than 22 percent of the Institute's grant resources.

A milestone in the Genetics Program was initiation of large-scale support to create special centers for research on genetic diseases. Seven centers were established—two in New York, two in California, and one each in Texas, Maryland, and Washington. Multidisciplinary teams of scientists are exploring the basic molecular nature of inherited diseases, coupling this with clinical studies of affected patients and members of their families. A key objective is to hasten application of new basic knowledge to health care delivery. Their studies include bone and structural deformities, inherited blood diseases, metabolic deficiencies, and disease-producing abnormalities of the chromosomes.

For example, chromosomal disorders are an important research interest in the genetics center at the University of Texas, in Houston. Errors in the structure and number of chromosomes are a leading cause of serious developmental disorders and mental retardation. It is estimated that at least one child in every 200 live births is so affected, and that the incidence of lethal chromosome abnormalities is 40 times greater in unborn infants. The latter is the primary known cause of spontaneous abortions or miscarriages.

Development of significant new chromosome staining technics, called banding, was greatly enhanced by work of the Texas investigators the past year. In essence, the stains, some of which are fluorescent, are absorbed in varying degree in different regions of the chromosomes, resulting in a banding pattern that is unique and distinct for each. This long-sought achievement makes it possible to distinguish the chromosomes reliably as belonging to one or another of the normal 23 pairs. In some instances it is possible even to determine, for these pairs, which were contributed by the mother and which by the father. Moreover, it appears possible to distinguish visually very discrete banding differences in the chromosomal DNA makeup. All of this promises to increase vastly the understanding of the nature of chromosomal abnormalities.

Trauma

Funds were awarded for a new center for research on trauma, bringing to 10 the number of trauma units supported by the Institute. Scientists in this center, at the University of California's San Francisco General Hospital, are studying problems of wound healing, blood microcirculation and coagulation, and lung dysfunctions caused by injuries. Other trauma program investigators previously had shown that hemoglobin in stored blood gradually loses its ability to release oxygen into the tissues. This was associated with depletion from the red cells of a normal constituent called DPG (diphosphoglycerate). This depletion results from the use of citrate, a common anticoagulant. It has therefore been urged that critically injured persons needing blood transfusions be given fresh blood when possible. Unfortunately, fresh donor blood is seldom quickly available. More recently, the San Francisco group has found preliminary evidence which suggests that a simple phosphate solution infused intravenously into patients who have received stored blood, and whose levels of blood phosphate are low, helps restore the ability of their red cells to release oxygen to the tissues. These studies may lead to techniques permitting the safer use of banked blood in emergency situations.

Diagnostic Radiology

Grants for two new centers for diagnostic radiology research, the first to be supported by the Institute, were awarded to scientists at Harvard Medical School and the University of Chicago. Their mission is to improve technologies for visualizing tissues and organs, and to apply them in treatment of disease processes. Shock, liver disease, or toxic agents may cause acute kidney failure. In patients so affected, blood flow through the kidney cortex is markedly impaired as a result of constriction of small vessels. The Harvard group is investigating this problem by monitoring the washout from the kidney of radioactive xenon injected into a catheter in the renal artery. This technique is being used to study the effectiveness of vasodilator drugs as a measure for reversing the vasoconstricion and thereby preventing permanent kidney injury.

In the Chicago center, studies in nuclear imaging are facilitated by use of the university's cyclotron and related research supported by the Atomic Energy Commission. Using ammonia labeled with the short-lived radioisotope N^{13} produced in the cyclotron, the investigators produced scintillation camera images of heart muscle which are remarkably free of image blurring caused by the surrounding or contained blood. Preliminary data suggest the technique may also be useful in other areas of investigation, particularly in brain imaging.

Pharmacology-Toxicology

Fundamental investigation of drug-enzyme interactions was linked to therapeutic effects in patients with the award of funds for a new five-year program of study at the University of Florida. Carbonic anhydrase is an enzyme abundant in red blood cells, with a crucial role in the transport and elimination of carbon dioxide from the body. The Florida group showed the enzyme also is active in the membranes surrounding the brain during formation of the cerebrospinal fluid (CSF) from blood plasma. Moreover, inhibition of carbonic anhydrase activity in this system with such drugs as acetazolamide reduces the concentration of bicarbonate in the cerebrospinal fluid, with a corresponding reduction in fluid volume and pressure. The scientists demonstrated the effective use of acetazolamide in the treatment of hydroencephalic patients whose CSF brain passageways were not completely occluded. It is hoped that a similar benefit can be obtained in patients suffering elevated spinal fluid pressure due to injury.

Engineering in Biology and Medicine

During the year a thorough assessment was made of the goals and opportunities for research and development which could improve the services of clinical laboratories. Attention was given to development of fully automated analytical instruments systems. A 78-page report, "The Mechanization, Automation, and Increased Effectiveness of the Clinical Laboratory," was widely distributed to interested scientists and engineers.

Research Training

The NIGMS provides about one-third of the NIH financial assistance which is helping unusually talented young men and women attain competence in biomedical research. This support insures for the future a supply of thoroughly trained investigators who will carry on, expand and launch new biomedical programs commensurate with the public's expectation of progress in the conquest of disease.

MARC Program (Minority Access to Research Careers)

The Institute initiated a new fellowship program to strengthen biomedical research and teaching in four-year schools serving predominantly ethnic minority students. Qualifying candidates are undertaking additional biomedical science training for periods up to three years, with the expectation of returning to their home faculties following completion of studies. Fellowships are also offered to help outstanding scientists visit and assist minority schools in the further development and conduct of basic medical research and teaching. The goal of the program is to attract and prepare more minority students for the Ph.D. degree and for careers in the biomedical sciences, enabling them to contribute significantly to the Nation's total health effort.

Acupuncture

The NIGMS has been assigned overall responsibility for acupuncture research. Guidance and recommendations were obtained from an advisory group appointed by the Director, NIH, and comprised of international authorities in the fields of anesthesiology, neurology, neurophysiology, phychology, and related basic and clinical disciplines. Workshops are being organized to develop necessary criteria for research in surgical anesthesia and the management of chronic pain. Investigations will be supported on the effects of acupuncture on various body functions, including the nervous system, circulation, respiration, and metabolism. The applicability of acupuncture to patients in this country and its effectiveness in comparison with other methods of anesthesia or therapy will also be determined. The effort includes an extensive survey of the available world literature on acupuncture, and cooperative endeavors with other NIH components, principally the Fogarty International Center and the National Institute of Neurological Diseases and Stroke.

National Institute of Neurological Diseases and Stroke

Spinal Cord Injury

In an important new initiative undertaken during the year, the NINDS awarded 18-month grants to six institutions to develop promising approaches to the national problem of spinal cord injury. Each year spinal cord injuries add an estimated 5,000 to 10,000 persons to the Nation's more than 100,000 paraplegics. It is expected that some of these feasibility and pilot studies will develop into Acute Spinal Cord Injury Clinical Research Centers. Work at these centers is directed toward preventing or lessening the severity of paraplegia by prompt diagnosis and treatment.

Early reports on these studies provide hints of the mechanisms which produce the destructive changes that occur immediately after injury, and of potential methods for influencing these processes. Additionally, NINDS is intensifying its basic research on nerve growth and regeneration in the central and peripheral nervous systems with the hope that results may benefit some who are already paralyzed.

The electrical "by-pass" approach to the problem of paraplegia is also being studied in the Institute's Laboratory of Neural Control. This laboratory is studying the nerve cells in the brain and spinal cord which control the muscles of the body, with the specific aim of effectively "by-passing" breaks in the spinal cord or damaged areas of the brain due to injury or stroke.

Stroke

Stroke ranks third among leading causes of death in this country, taking over 200,000 lives a year. In addition, stroke often incapacitates those it does not kill. It is estimated that there are 2 million victims of stroke alive today, one-third of whom were wage earners at the time they were stricken. The resultant economic loss is estimated to be in the billions of dollars.

In the hope of cutting the toll in human suffering and economic loss, the NINDS has mounted a strong program in cerebrovascular disease, including sponsorship of 17 clinical research centers, some 60 research projects, and two national cooperative clinical drug trials.

Cerebrovascular disease presents one of the most difficult problems of diagnosis, owing to the delicacy and inaccessibility of the brain and its circulation. New, safe, and effective diagnostic techniques are a primary need. This year a diagnostic device called a tomoscanner was installed at NIH, with which, it is expected, it will be possible to scrutinize more closely the intricate arterial system of the brain.

The development of better drug therapy for cerebrovascular disease also received attention. This past year hexobendine, a new vasodilator, urokinase, and aspirin were studied with particular reference to the stroke problem.

Hearing, Speech, and Language

Many young people, as well as many in the over-65 age group are excluded from normal living because of hearing and speech disabilities. Prevention, early detection, treatment and improved aids are imperative in the young if hearing loss is extensive so they may develop speech and language and be educated in regular classes. Effective treatment and improved aids are also important to senior citizens.

Early in 1972 a new section in Collaborative and Field Research, NINDS, was established to develop and coordinate a directed research program to improve the outlook for those afflicted with communicative and other sensory disorders. Contracts are being negotiated to begin research projects in Infant Hearing Health, Hearing Aid Tailoring, and Cross-modality Sensory Aids.

Inner ear deafness and early detection of deafness are among the important problems under investigation at the five clinical research centers supported by the NINDS in the area of communicative disorders.

Epilepsy

In a continuing effort to help the estimated two to four million Americans who have epileptic seizures, the Institute undertook an extensive program to develop new antiepileptic drugs and to evaluate drugs which have not been approved for general use. Gas-liquid chromatography measurement of drug levels was shown to be of value in research on effectiveness of drugs, and also for use of doctors in determining proper dosage. Basic brain and seizure mechanics were among important problems under study at five epilepsy research centers supported by the NINDS.

Multiple Sclerosis

Multiple sclerosis presents a most discouraging picture for several hundred thousand Americans in early adult life. No effective treatment is yet available, but the Institute is pursuing many avenues of research which provide valuable information about potential causes of the disease, such as sensitization of the patient's immunological system to his own brain tissue by a viral agent or other mechanism.

The Institute also supports research at a unique facility for the study of multiple sclerosis and related neurological disorders. The Reed Neurological Research Center at UCLA has extensive laboratory facilities, research beds for the study of patients, and an outpatient research service.

Virus Research

Search by Institute scientists for a viral agent related to chronic degenerative disorders of adults and children has been rewarding. It was first discovered that kuru, a disease of the natives of New Guinea, could be transmitted to animals. Later, it was found that Jakob-Creutzfeldt disease, a rare neurological disorder found throughout the world, could also be transmitted to apes and monkeys. This past year, still a degenerative neurological disease of sheep, scrapie, has been transmitted to primates. The discovery that these diseases are caused by some "infectious filterable" agent, not yet identified, has greatly broadened the field of research.

In addition to the successful transmission of these diseases to primates, several years ago a measles virus was isolated from brain tissue in patients suffering from a fourth disease, subacute sclerosing panencephalitis (SSPE), a fatal neurological disease of children. This past year, the virus was also isolated from the lymph nodes of SSPE patients.

Cerebral Death

The pilot study on cerebral death launched by the NINDS last year is well underway. Cases contributed by the collaborating institutions are now being analyzed, and before the end of 1973 data on which to base a more precise definition of death is expected to be available.

Bureau of Health Manpower Education

Enactment of the Comprehensive Health Manpower Training Act (P.L. 92–157) and the Nurse Training Act (P.L. 92–158) on November 18, 1971, greatly amplified the Bureau's responsibility and capability for increasing the number of personnel in the Nation's health manpower pool, particularly in health manpower shortage areas.

The legislation put new emphasis on expanding enrollment in schools of medicine, osteopathy, dentistry, optometry, podiatry, pharmacy, and veterinary medicine, training family practitioners and new types of health personnel, increasing minority representation in medicine, dentistry, and other professional fields, and alleviating shortages in underserved areas. It established a program of grants and contracts, the Health Manpower Education Initiative Awards, to improve the distribution, supply, quality, utilization, and efficiency of health personnel.

Implementation of a program was begun to support Area Health Education Centers (AHECs) in medically underserved areas. The Centers will provide residency training and clinical instruction for undergraduate medical students, continuing education for practicing physicians, plus training for other health professions. The nucleus of each AHEC will be an established public or nonprofit hospital which will provide the training.

ADMINISTRATIVE CHANGES

Dr. Peter L. Eichman was named Deputy Director of the Bureau and Dr. Louis M. Rousselot was named Special Assistant to the Director.

Two new programs were established in the Office of the Director as a direct result of the new legislation. The Office of Health Manpower Opportunity, with Dr. George Blue Spruce as Director, funds projects to increase the number of health professionals in shortage areas and encourage individuals from minority and disadvantaged backgrounds to enter the health professions.

The Office of Special Programs, with Dr. Douglas A. Fenderson as Director, administers grants and contracts to improve the supply and distribution of health personnel and expand the training of physician's assistants.

A new 20-member National Advisory Council on Health Professions Education was appointed, replacing two Councils which had similar functions under previously existing health manpower legislation.

Bureau appropriations rose from $428,048,000 in FY 1971 to $673,600,000 in FY 1972, the number of permanent, full-time employees increased from 737 to 783.

Division of Physician and Health Professions Education

Upon enactment of the Comprehensive Health Manpower Training Act, Dr. Harry W. Bruce Jr., Director of the Division of Physician and Health Professions Education, and his staff conducted a series of seminars to explain the legislation. The division was given responsibility for carrying out a major part of the activities authorized. The group conducted briefings at six cities for representatives of health professions schools.

Federal aid for educating health professionals increased to a greater degree than in any previous year. Nearly $249 million was allocated in grants to 285 institutions.

For the academic year beginning in the fall of 1972, the schools have assured an expansion of first-year enrollments to 29,600, an increase of 2,150. Of the 2,150 additional students, 1,020 will be medical students. A total of $155.2 million was awarded to schools in capitation payments.

NEW SCHOOLS

Start-up grants of $3.3 million were awarded to help 10 new schools (5 medical and 5 dental) get started. These new schools expect to enroll 342 students by June 1973. Two schools, Dartmouth Medical School and College of Medicine and Dentistry of New Jersey-Rutgers University received $2.5 million to help convert from two-year to degree-granting medical schools. The Division also awarded 18 grants totaling $11.1 million to schools in serious financial straits to help them meet operating costs and maintain accreditation.

Under a new program, 52 grants amounting to $5 million were made to public or private nonprofit hospitals to conduct training programs in family medicine, and grants amounting to $2 million supported preceptor programs enabling undergraduate students to obtain experience in primary care in a community. Nine schools received grants totaling $1 million to provide advanced training for health professions teachers.

Grants totaling $12,597,364 were awarded to support the construction of teaching facilities in health professions schools. These funds will result in the addition of 184 first-year places at the schools.

More than 30,000 students are estimated to have received student aid funds totaling $30 million in health professions loans and $15.5 million in health professions scholarships.

New and continuation special project grants amounting to more than $50 million were made to assist schools in expanding enrollment, shortening training and increasing the number of minority students.

EDUCATIONAL EXPERIMENTS

Contracts awarded by the Division totaled $5.7 million, more than nine times the amount the previous year, for a variety of educational experiments.

The University of Washington was awarded a contract to provide medical education in four States through a cooperative arrangement with schools in Washington, Alaska, Montana and Idaho. The University of Washington, with the only medical school in the area, will provide faculty for part of the training at the other schools and at community clinics in the four-state area.

Michigan State University will begin developing a pilot program to train medical students in physician shortage areas. The University's College of Human Medicine will attempt to develop a program in which small groups of students will receive medical education in communities not near a medical school.

The University of the Pacific in Northern California received a contract to study the feasibility of developing and operating a school at which several types of health care professionals could be trained in a common interdisciplinary educational system.

Hahnemann Medical College and Hospital at Philadelphia, Pennsylvania, was awarded a $388,011 contract to develop a program of telecommunications-supported undergraduate medical education oriented toward family medical practice. It will be conducted within community hospitals in the area of Wilkes Barre, Pennsylvania.

Wilkes College of Wilkes Barre, Pennsylvania, received a contract to develop the first two years of a six-year combined B.S.-M.D. degree program.

RETRAINING PH.D.'s

A contract was awarded to the University of Miami in Florida, to conduct the final year of a two-year program to retrain holders of Ph.D. degrees as Doctors of Medicine and to evaluate the suitability of such a program for widescale use.

The University of Pennsylvania received a contract to develop, conduct and evaluate the effectiveness of a program for the retraining of Ph.D.'s in the biological and physical sciences for new careers as doctors of dental surgery.

Ohio State University College of Medicine will make available to other health profession schools teaching materials developed for an independent study program of medical education.

The University of Southern California at Los Angeles and Tufts University at Medford, Massachusetts, were awarded contracts to develop and conduct model programs to enable graduates of foreign dental schools obtain licensure in the United States.

A survey of health professions education facilities was initiated by the Rensselear Research Corporation of Utica, New York.

Division of Nursing

NURSE TRAINING ACT AWARDS

A total of 875 nursing education programs received capitation grants, which are general support grants to encourage increased enrollment, train nurse practitioners, and improve nursing education. These grants are expected to result in 9,600 additional enrollments in the coming year. Under another new program, 125 schools received financial-distress grants to remain in operation, maintain quality education, or attain accreditation.

Recognizing the expanded role of the nurse, the Division awarded 15 contracts to prepare nurse practitioners—registered nurses qualified for highly independent action in the care of patients. During the next three years, the contractors—university and hospital nursing schools and a community-based medical care development plan—will train an estimated 1,300 practitioners in such fields as pediatrics, nurse-midwifery, family-oriented nursing, and the care of chronically ill patients.

Awards to 21 schools under the extended construction authorities will create 1,136 new places for first-year students and maintain 3,850 student places. Through the extended provisions of nursing student aid, an estimated 30,000 students received loans for nursing education and an estimated 19,500 scholarships; 3,200 registered nurses received traineeships for long-term study to prepare for teaching, supervision, administration, or clinical specialization.

The Division negotiated 11 new contracts to encourage full utilization of educational talent for nursing. The first seven grants under the new authority will similarly advance recruitment and upward mobility. Community colleges in Alabama and Hawaii, for example, will prepare practical nurses for R.N. careers; R.N. programs are being started for students from Appalachia and the Gila River Indian community. Another project, YOU-IN (Youth Opportunities Unlimited in Nursing), resulted in published brochures that describe an innovative recruitment plan for nursing and community groups.

MANPOWER NEEDS AND RESOURCES

A national survey of office nurses was begun to ascertain the educational limitations and conditions of employment that impede them from assuming primary care roles. Consultation was provided to help seven States and Territories plan for nursing resources.

RESEARCH

Conferences, contracts, and grants were utilized to advance research in education with a view to changes in nursing practice. Conferences were convened to discuss accountability for patient care and nurse staffing research and its implications for practice.

A contract with the School of Public Health at the University of North Carolina will result in the first instrument for systematic evaluation of family nurse practitioners. Through an interagency agreement, the Veterans Administration Outpatient Clinic in Los Angeles will delineate appropriate components of primary nursing care for ambulatory patients.

Among 34 continuing and 18 new educational research projects, one at the University of Wisconsin, will enable investigators from all contributing health professions to design a program of research in expanded nursing roles, and to establish training priorities.

Under two programs of research training—Special Pre- and Postdoctoral Nurse Fellowships to individual nurses, and Nurse Scientist Graduate Training Grants to institutions—a total of 268 nurses enrolled in 53 universities.

Division of Allied Health Manpower

Expanded opportunities for education and career development of allied health manpower were channeled into activities to recruit minorities and veterans, new approaches to determine job performance competence, and improved organization of programs. Efforts were directed toward increasing manpower for administrative and supervisory positions in health services organizations and in delivery of medical and dental services.

GRANT PROGRAMS

The Division awarded $10.5 million in Special Improvement Grants to 145 junior colleges, colleges, and universities. These were the first awards in this program, which was authorized by the Health Training Improvement Act of 1970. They may be used for enrollment expansion, curriculum improvement, program coordination, and programs for veterans and the disadvantaged.

Grants and contracts totaling $14.7 million supported activities to develop new educational techniques and methods, new types of health personnel, and strengthening of allied health professions training.

Grants to institutions totaling $2.9 million, aided more than 2,000 persons to obtain advanced training as educators, administrators, supervisors and non-research specialists.

A total of $9.5 million was awarded to 17 accredited schools of public health and 51 other institutions offering graduate public health training for curriculum improvement and development.

During the year, 6,500 trainees in 400 graduate public health training programs received financial assistance.

OPERATION MEDIHC

Operation MEDIHC (Military Experience Directed Into Health Careers) agencies operated in 50 States, the District of Columbia, Puerto Rico and the Virgin Islands. The state-oriented counseling and referral programs aided 4,900 veterans to find jobs or training to capitalize on their military experiences, with $1.4 million in support.

Division of Dental Health

TEAM/DAU

The Training in Expanded Auxiliary Management (TEAM) grants program funded 12 projects totaling $1.98 million to teach students to work with a team of auxiliaries trained in expanded functions. Division support for Dental Auxiliary Utilization (DAU) programs in 54 dental schools was $2.27 million.

The Dental Manpower Development Center in Louisville, Kentucky, was the site of nine TEAM training conferences for dental faculty, dental association representatives, program directors of the Army's TEAM program, members of State Boards of Dental Examiners, and auxiliary supervisors.

PROJECT ACORDE

Project ACORDE (A Consortium on Restorative Dentistry Education) was funded by Division contracts totaling $666,345 for the development of instructional materials. It will provide modular, skill-teaching, self-instructional materials in 20 areas of restorative dentistry.

INTERNATIONAL STUDY, OPINION SURVEY

A contract was awarded to the World Health Organization for a three-year study of representative dental care systems in Australia, West Germany, Japan, Norway, New Zealand, and Bulgaria, the first cross-cultural study of its kind. The DDH share of the cost will be $335,000.

The Division updated its continuing study of public opinion and attitudes toward dental health through a contract with the National Opinion Research Center. The Center interviewed 1,600 persons to analyze attitudes toward fluoridation, control of periodontal disease, expanded use of auxiliaries, and dental services.

PREVENTIVE DENTISTRY

The Division continued its public education activities in support of community water fluoridation. As of December 31, 1971, fluoridation reached more than 95 million people: 86,135,682 had access to water supplies with a fluoride content adjusted to optimum level, and another 9,449,213 drank naturally fluoridated water.

A public education campaign to prevent periodontal disease began in July 1971 with nationwide release of two television spot announcements. More than 100,000 copies of informational literature on flossing and brushing teeth to prevent perio were mailed in response to inquiries generated by the television spots.

CONTINUING EDUCATION

In October 1971, simultaneous broadcast of a dental education course began over educational television networks in Minnesota, Iowa, Nebraska, and the Dakotas (MIND). The system was developed and will be evaluated by MIND, Inc., under contract with the Division.

GRANT AWARDS

Nine research grants totaling $480,138 were awarded for a study of new duties for dental hygienists, the preparation of position papers on an improved oral care system, and development of dental health care models of Southwest cultures. Four research training grants totaling $170,768 supported training in dental teacher education, dental public health and socio-dental research.

Division of Manpower Intelligence

PROGRAM ANALYSIS

During its first full year of operation, the Division implemented organizational changes. Prior to the enactment of the Comprehensive Health Manpower Training Act of 1971, detailed analyses of several legislative proposals were prepared. Student loan and scholarship awards and capitation awards for schools of nursing and the health professions were computed.

HEALTH MANPOWER RESOURCES AND REQUIREMENTS

Studies were initiated to determine the impact of various factors on the future supply and need for health manpower. An area resource data file was developed to implement legislative provisions designed to improve geographic distribution of health manpower.

INTERNATIONAL HEALTH MANPOWER STUDIES

A new office was established for analysis of the training and utilization of foreign medical graduates in the United States. A data bank on foreign graduates was planned. A census of U.S. citizens enrolled in foreign medical schools was begun. Studies in selected foreign countries were initiated to compare patterns of utilization of health manpower and education programs.

MANPOWER INFORMATION

Pilot projects have been initiated with two Regions toward the long-range goal of establishing a linked, computer-based information exchange system.

A survey of all Federal departments and agencies with programs for health manpower training was completed. Companion studies of financial support for health manpower education and training by States and private foundations were begun.

National Library of Medicine

Library operations continued to show growth in almost all sectors: 233,000 journal articles were indexed for MEDLARS, up five percent over 1971; 58,000 new items were acquired and brought the total collection to 1,408,000. Reference queries and interlibrary loans also increased over last year.

The year saw gains in the development of a functioning network of medical libraries. MEDLINE became operational in 1972 and is now a fully integrated component of the network. MEDLINE, an acronym for MEDLARS On-Line, provides instantaneous access to biomedical journal article references.

International cooperation in MEDLARS services was highlighted this year by a policy-level meeting of the directors of the eight foreign MEDLARS centers. The scope of the meeting encompassed four areas: existing bilateral *quid-pro-quo* arrangements (usually MEDLARS tapes in exchange for indexing services); assessment of operating experience and performance, needs, and policy issues; availability of MEDLINE and MEDLARS 11; and potential for future international cooperation.

On-Line Information Retrieval Systems

MEDLINE

At the end of June 1972, the MEDLINE data base included over 450,000 citations from 1,148 of the leading journals indexed for *Index Medicus*. Early in February, a communications network became operational, providing toll-free telephone line access from 35 cities to the MEDLINE data base in NLM's new IBM 370/155 computer. All Regional Medical Libraries and MEDLARS Centers will have access to the network, and user agreements with Resource Libraries participating in regional activities are being developed.

By the end of FY 1972, there were 105 active MEDLINE Centers in the U.S.; this included 71 four-year medical school libraries. Over 6,000 MEDLINE searches were performed in its first nine months of operation.

TOXICON

A nationwide, on-line information retrieval service became operational, giving environmental health scientists, clinicians, and other health professionals direct access from remote locations to NLM's extensive store of computerized toxicological/pharmacological information and data. The new system is called TOXICON, for "*Tox*icology *I*nformation *C*onversational *O*n-Line *N*etwork."

A subscriber to TOXICON, by utilizing one of a wide choice of existing terminal devices connected to TOXICON through the telephone network established for MEDLINE, is able to conduct an immediate search of the data bases compiled and maintained by NLM's Toxicology Information Program. These expanding data bases are a principal storehouse of published human and animal toxicity studies, adverse drug reactions, poisoning cases, effects of environmental chemicals or pollutants, and analytical methodology.

Experimental Networks

At the close of the fiscal year, the Lister Hill National Center for Biomedical Communications had two experimental networks in operation—a voice radio network via the ATS–1 satellite to provide medical consultation between community health aides in Alaskan villages and physicians at Native Health Service Hospitals, and a leased microwave television network connecting Dartmouth's Medical School and University Hospital with Claremont General Hospital. Contracts had been signed by the Center to place university-developed computer-aided medical instruction programs on the wireline network and make its services available to other institutional users, and to use cable television to connect Mt. Sinai Medical Center in New York with an apartment complex in East Harlem for experiments relating to patient selfcare and general health education.

Medical Audiovisual Activities

The Library's National Medical Audiovisual Center in Atlanta, Ga., has been developing, as part of its clearinghouse function, an on-line data base of information on audiovisual instructional materials to be integrated with MEDLINE. Review of instructional material acquired for the clearinghouse program was begun in cooperation with national medical specialty organizations. The Center restructured its distribution system for audiovisual materials, developed a series of 31 workshop and seminar programs for instructional needs, and supported instructional materials development efforts at many medical schools.

Extramural Support

The Medical Library Assistance Extension Act of 1970 enabled the Library to make 659 awards for $6,837,492.

New or expanded program accomplishments during the fiscal year included:

- Initiation of a training program to prepare physicians and health information specialists in the development of computer technology for medical education and the delivery of health care.
- Expansion of the Special Scientific Projects Program which funds eminent scholars who are preparing comprehensive treatises on health.
- Marked growth of International Program activities which underwent a 54% increase in the number of active Public Law 480 projects.

Publications

Accomplishments included issuance of the sexennial *NLM Current Catalog* (1965–1970); a comprehensive index to the *Report of the Secretary's Commission on Pesticides and their Relation to Environmental Health*; assuming of responsibility for publishing the monthly *Current Bibliography of Epidemiology*, formerly published by the American Public Health Association; publication of the Lister Hill Center's *Report to Congress*; and a revised National Medical Audiovisual Center *Motion Picture and Videotape Film Catalog*.

Clinical Center

The Clinical Center continued to provide clinical research facilities and quality patient care services for the National Institutes of Health during Fiscal Year 1972, and to provide opportunities for young physicians and other professionals to prepare for careers in research or academic medicine.

Ambulatory Care Facility Planning

Over the last six years the focus of much clinical research has been moving into the outpatient setting, for many reasons. Research interests are changing from remedial and corrective maneuvers to investigation into prevention, early detection and treatment of disease. Cancer and coronary artery disease are examples. Population screening is becoming a part of research. In addition, prevention of chronic disease and resulting disability becomes more important as the average life span increases. Research into the cause of chronic deterioration and methods to arrest its progression requires multiple and long-term follow-up visits, usually when the patient is ambulatory.

Emphasis in the past was on the study of disease in patients in isolation from the environment. Now, environmental factors are receiving increased consideration. Reduction of lung cancer by cessation of smoking, reduction of risk of coronary artery disease by dietary control in the hyperlipidemic, and prophylactic exercise in the sedentary are all difficult to study in a controlled inpatient environment where life and risk factors are not encountered. Study therefore is increasingly appropriate on man left in his environment outside the hospital and in ambulatory care facilities.

These factors have led to a shift in NIH clinical research emphasis to the ambulatory setting. To provide adequately for this change in focus, the need for new space became evident. Serious planning for an addition to the Clinical Center for ambulatory care research was undertaken in September 1971.

By January 1972 a proposal for a facilities planning contract had been written. It stated that the new facility should include 200,000 net square feet of space and accommodate 115,000 additional outpatient visits per year. Included were a general surgical suite to replace the existing 20-year-old facility, a modern diagnostic radiology department, expansion of service areas, and laboratories and offices to accommodate new physicians.

In March 1972, a contract was made with a firm of facility planning consultants to develop a definitive program of requirements. The consultants interviewed representatives of all nine Institutes to determine the requirements for each during the target period 1978–1980.

Education and Training

A new program of elective courses for nursing students was inaugurated in April 1972. Open to students from any baccalaureate program in nursing, the program is designed to provide an in-depth exposure to a nursing specialty in a research environment.

Additional educational opportunities were made available to employees at all levels. Enrollment in the Adult Education Program totalled 42; 44 employees attended Upward Mobility College; and 98 staff members received supervisory management training.

Patient Load

Patient admissions numbered 4,570. Readmissions for followup totalled 2,880. Outpatient clinic visits climbed to 39,770, an increase of 1,573 over the previous year.

The average length of patient stay remained approximately the same, at 25 days. The total number of patients admitted to the Clinical Center from July 6, 1953 through June 30, 1972 was 67,240.

Division of Biologics Standards

Blood Donor Screening for Hepatitis

Concern has been increasing over the growing incidence of hepatitis resulting from blood transfusions. There are some 30,000 cases of transfusion-caused hepatitis reported each year, and approximately ten percent of these result in death.

Rapid advances in the field of hepatitis research have led to development of practical laboratory tests to increase the safety of blood transfusions. The DBS has evaluated the efficacy and practicability of these test procedures in blood-donor screening for detection of hepatitis-associated antigen. Nine manufacturers have been licensed over the past 18 months for commercial distribution of test materials. These tests are capable of detecting only 20 to 25 per cent of the blood implicated in causing post-transfusion hepatitis, but an intense search for more sensitive tests is proceeding. This year, a new procedure was developed which promises to significantly increase detection ratio and plans were completed to begin using it in blood-donor screening in August 1972.

This past year, DBS promulgated Federal regulations to require testing by all licensed blood banks of blood, plasma, or serum for the presence of hepatitis-associated antigen and elimination as donors of persons whose blood tests positive for the antigen. These regulations became effective on July 1, 1972.

Serum Hepatitis Research

The Division undertook studies of serum hepatitis in order to gain a better understanding of the disease and ways that it may be prevented or treated. During the past year progress was made with chimpanzees as an animal model. DBS scientists demonstrated that when antibody-free chimpanzees were inoculated with materials positive for hepatitis B antigen (an antigen associated with serum hepatitis), most of them developed evidence of hepatitis B virus infection. Thus the chimpanzee appears to be a promising model for studying protective immunity as well as pathogenesis and the carrier state of serum hepatitis.

DBS Becomes FDA Bureau of Biologics

In May 1972, Secretary Elliot L. Richardson announced transfer of DBS from the National Institutes of Health to the Food and

Drug Administration. Therefore, on July 1, the DBS, which has been a component of the NIH for 17 years, officially became a sixth Bureau—the Bureau of Biologics—in the FDA. The Bureau will continue to use the NIH facilities and buildings that it has occupied.

Division of Computer Research and Technology

Services and Facilities

Use of NIH central computing power increased again this year. The work load grew from 87,000 to 125,000 jobs per month with a concomitant increase in the number of interactive terminals (250 to 400) and remote job entry terminals (18 to 27). In order to support this use by scientists and administrators, a larger and faster computer replaced one of the older machines in the 3-computer central complex and a new facility for computer-output-microfilm/microfiche (COM) was installed.

Systems Development

Many new applied systems were developed and implemented in order to assist research and administrative activities. The generation of source language programs to create, update and reformat files and to retrieve data from those files has continued. The data from the National Cancer Institute's Bioassay Program has been computerized so that experimental results on large numbers of animals can be evaluated, correlated, and compared. A system designed for collection, storage and analysis of data on cholesterol level and its relation to coronary artery disease was designed for the National Heart and Lung Institute. Intensive-care monitoring also came into the purview of the Division with the design of a system that performs vital sign monitoring with feedback to clinicians and nursing staff.

Research Developments

DCRT research projects are both individual and collaborative and run the gamut from very basic research to patient care applications. Studies of protein interaction at the molecular level using nuclear magnetic resonance spectroscopy as well as automatic question-answering and problem-solving, automatic reduction and pattern recognition were fundamental research areas investigated.

An international symposium on Numerical Methods in Chemistry was held during the spring. On-line retrieval of chemical information and computer modeling of the nervous system were other projects undertaken. In patient care research, new programs for electrocardiogram analysis are being evaluated. Analog cineangiographic data is being digitally analyzed in patients with coronary artery disease and DCRT is cooperating with the Nuclear Medicine

Department of the Clinical Center in developing programs to evaluate cerebral and hepatic blood flow.

Education

The number of courses which DCRT offers to NIH staff so that they can use computers more efficiently increased. So did the number of attendees. This year more than 2,000 people enrolled, as compared to 1,700 in 1971.

Division of Research Grants

The number of research grant applications referred and reviewed by the Division increased over that in the previous fiscal year. Competing and non-competing applications numbered 23,239 for the National Institutes of Health and the Health Services and Mental Health Administration. Of these, more than 14,000 applications were assigned for technical merit review. Approximately 76 percent of competing applications were assigned to the National Institutes of Health. More than 85 percent of the applications were provided with initial scientific review by DRG study sections.

A paper entitled, "Who reads your project-grant application to the National Institutes of Health?" (Federation Proceedings, Vol. 51, No. 1, January–February 1972), written by a DRG executive secretary to help scientists prepare better grant applications, was used as the basis for a panel discussion at the spring meetings of the Federation of American Societies for Experimental Biology.

There was a 1.2 per cent decline over the previous year in fellowship applications received and processed, 14 per cent increase in competing training grant applications, and 4.3 per cent increase in research career development award applications.

Several workshops and conferences were sponsored during the year by the study sections to examine the state of the art in a variety of fields. Among them was a workshop on "Current Bacteriology and Mycology Topics," at which participants discussed clinical infectious disease in the U.S. and other parts of the world, recent progress in cellular immunity, the relationship of ultrastructure of pathogenic organisms to disease, and current problems in syphilis and gonorrhea. Another was a workshop on "Plasma Amino Acids" centering on amino acid transport in kidney, intestine, and brain. Other topics discussed were effects of the route of administration of amino acids or protein hydrolysates on serum amino acid levels in infants and adults, the serum aminogram in starvation, diabetes, and exercise, dietary disproportions of amino acids and their influence on satiety; the role of polyribosomes in protein synthesis, and their responses in the liver following amino acid administration.

Another was a conference on "Dynamics of the Interactions of Arthropod Vectors with their Hosts and with Infectious Agents" at which participants appraised the status of research and on determinants of field transmission of important disease agents.

Services from the IMPAC system were expanded in several areas including equipment accountability and the indirect cost management system. A study was completed to investigate the feasibility of automating the Division's Investigator Record Card files by use of computer-generated microfilm files.

An evaluation project was developed to measure the training impact of NIH research grant programs by using NIH Research Grant Manpower Survey findings.

The Division's employee training program was stepped up, with requests for training received from 267 employees. Twenty DRG employees attended the Upward Mobility College.

Division of Research Resources

The Division of Research Resources in Fiscal Year 1972 concentrated its efforts in areas offering potential for substantial development in biomedical facilities.

Clinical Information Program (CLINFO)

One important new effort, involving both the Biotechnology Resources Branch and the General Clinical Research Centers Branch, focused on the potential of computer technology in support of human clinical investigation.

Computer applications in hospitals have steadily advanced during the past decade, but there remains a definite need for computer systems and technologies specifically designed to serve clinical research centers. Interacting with three on-going centers, a preliminary data-gathering was begun in preparation for a pilot project to study a complete clinical research setting for adaptability to computer technology.

Institutional Animal Resources Program

In response to the enactment of the Animal Welfare Act of 1970, the Animal Resources Branch in December 1971 moved to assist institutions to comply with the Act and new NIH policies on care and treatment of animals. The increased emphasis on improvement of research animal facilities has resulted in significant changes at many institutions. Most of the new funds were directed toward renovation of facilities, purchase of caging, autoclaves, and other equipment. Also provided were initial support funds for salaries of additional professional and technical personnel. The majority of the laboratory animal resources supported under this program are utilized by health scientists working on NIH categorical study projects.

Minority Schools Biomedical Support Program

Announced in December 1971 and implemented June 1972, the Minority Schools Biomedical Support program is designed to strengthen the health-related and research training capabilities of four-year colleges, universities, and health professional schools in which students are drawn mainly from ethnic minority groups. Initial awards were made to 38 institutions, with 66 percent to baccalaureate degree-awarding schools.

High Voltage Electron Microscopy

A milestone in the use of electron microscopy was reached when the Biotechnology Resources Branch gave final approval to support for two installations of one-million-volt electron microscope centers. Completion of the centers at the Universities of Wisconsin and Colorado will mark the first high voltage microscope resources in the country completely devoted to biomedical research.

High voltage electron microscopy permits three-dimensional observations of thick-sectioned biological materials, enabling extension of investigations on complex structures such as those in chromosomes, muscles, and the brain.

Access to a million-volt microscope previously was arranged for biomedical scientists by a DRR contract at the United States Steel Co. research laboratories in Monroeville, Pa. Research resulting from this contract arrangement clearly defined the promises and problems of this new technology.

Division of Research Services

The Division of Research Services provides NIH researchers with direct support in biomedical engineering and instrumentation, environmental control, testing and protection services, library services, medical art and photography, animal production and care, and media production.

Dr. Roger Estep, former Executive Assistant to the President of Howard University, was appointed Director of DRS, December 1, 1971. Dr. Estep replaced Dr. William B. DeWitt who died suddenly on August 8, 1971.

Significant initiatives were undertaken by the Management Analysis Office in computer-assisted evaluations of personnel, budget and service. The Laboratory Aids Branch was renamed the Veterinary Resources Branch.

Biomedical Engineering and Instrumentation

Improved methods were devised for identifying and reducing electrical hazards in surgical and patient care areas. Innovative techniques, exploiting closed circuit television, were made available for physiological monitoring and diagnostic procedures. Fundamental understanding of pharmacokinetic phenomena, especially as related to chemotherapy, was enhanced. A concentrated inquiry into the interactive mechanisms of implanted materials and living constituents was initiated.

Environmental Services

The Biological Control Program received priority emphasis. A large portion of staff time was spent in consultation and assessment of potential biological hazards, equipment use and procurement.

The Ad Hoc Inter-Institute Technical Committee on Biohazards completed its mission and submitted a final report to the Deputy Director for Science, NIH. As a part of the committee activities, DRS developed a computerized registry of microbial agents, tissue cultures, and animals maintained. This registry, now an ongoing activity, provides invaluable biohazard surveillance information. A contract was awarded to the Dow Chemical Company to test and maintain biological safety cabinets, high efficiency filters and other bio-control systems.

Library Services

The NIH Library provided on-line bibliographic searching through National Library of Medicine's new MEDLINE computer system. Library staff perform searches using the MEDLINE terminal or give individual instruction and guidance on its use. Bibliographic searches are also made through NLM's MEDLARS system.

Medical Arts and Photography

Services were increased and broadened with advanced scientific camera equipment, and increased use of outside contractors. New lenses increased the versatility of photomacrography, and new stroboscopic lighting increased high-speed photographic capabilities, particularly for recording movement of laboratory animals. A new inverted photomicroscope was obtained to permit a wider range of exposures and greater accuracy, particularly in photographing pathogenic materials in closed vessels.

Animal Programs

At the request of NIH investigators, several new inbred strains were added to the laboratory animal genetic repository. This activity fulfills NIH's needs and also is a resource of breeding nuclei and reference animals for investigators throughout the world.

The Animal Disease Investigation Service, in its first full year of operation, made over 100 calls to NIH laboratories to deal with disease conditions such as tuberculosis in primates, salmonellosis in dogs, and streptococcal lymphadenitis in guinea pigs.

Fogarty International Center

In Fiscal Year 1972, the Fogarty International Center for Advanced Study in the Health Sciences, by fostering international cooperation and collaboration, continued to advance knowledge in the biomedical and allied sciences.

Advanced Study

The Center, through its conferences and seminars, provides a forum for review and discussion of important biomedical and biosocial issues. By mid-1972, approximately 300 scientists, clinicians, and other professionals representing almost 40 foreign countries had participated in Fogarty Center conferences. Additional hundreds attended from leading research institutions in the United States.

The Center planned and held ten conferences to explore critical problems in clinical medicine, basic research, and medical education. Topics were: Histocompatibility Antigens in Man; Ethical Issues in the Use of Genetic Knowledge; Immunization in Tuberculosis; Reform of Medical Education III: Medical Education and Medical Care; Translation, Its Mechanism and Control; Taxonomy of Malaria Parasites; Numerical Methods in Biochemistry; Control of Movement and Posture; Biology of Animal Cell Surfaces; and Genetic Recombination.

The Conference Program also published the presentations, findings, and recommendations of these meetings. In Fiscal Year 1972, conferences held in previous years resulted in ten conference proceedings and reports.

Geographic Health Studies

Within the Geographic Studies Program, the Center undertook continuing studies of medicine and public health in the Union of Socialist Soviet Republics and the People's Republic of China, as well as in Europe.

The Center's active interest in the People's Republic of China began over two years ago when several studies in Chinese medicine were instituted. This activity resulted in the publication of a handbook, *Medicine and Public Health in the People's Republic of China.* The book is a compilation of original papers prepared by fourteen scholars, clinicians, and scientists with past or recent experience in mainland China, and is the first volume covering the health problems of mainland China to be issued in the United States since 1966.

To maximize the productivity of scientific and medical exchange missions between the U.S.S.R. and the United States, the Center issued two studies of Soviet medicine: *Medical Care in the U.S.S.R.*, and *The Soviet Feldsher as a Physician's Assistant.*

Fellowships and Scholars

Since its establishment in 1968, the Center has supported and administered the NIH's International Research Fellowship Program, designed to promote collaborative relationships between American biomedical scientists and brilliant and promising young foreign scientists. Last year approximately 135 International Fellows were at work in over 50 academic and research institutions, including the NIH, throughout the United States.

Through its Fogarty Scholars-in-Residence program, the Center brings outstanding scholars from the United States and abroad to NIH for varying periods of time. While at the NIH they engage in many different types of activity in exploring problems of science. Last year 13 scholars from six different countries were in residence at the NIH.

Support Functions

In addition, the Fogarty International Center provides administrative support to vital international activities.

For example, research abroad is supported by the NIH through the Special Foreign Currency Program (Public Law 480), administered by the Fogarty International Center. Paid for with U. S.-owned foreign currencies in eight to ten foreign countries, all projects are of a collaborative nature.

Health professionals from many foreign countries come to the United States each year for additional training. Responsibility for arranging for the training of medical and allied health personnel supported by the World Health Organization and the Pan American Health Organization became another of the Center's administrative assignments during 1972.

Hundreds of foreign scientists, from doctoral candidates to Nobel Prize winners, are attracted to the NIH. The International Visitors Center within the Fogarty Center provides a central point where these scientists may receive guidance and assistance. In addition, the NIH offered an opportunity to over 200 qualified foreign scientists to work and learn with NIH scientists. During Fiscal Year 1972, responsibility for administration of this program was transferred to FIC's International Visitors Center.

NATIONAL INSTITUTES OF HEALTH EMPLOYMENT BY COMPONENT, JUNE 30, 1972

Component	(Permanent full-time) 1971	Comparison between fiscal years 1971-1972	(Permanent full-time) 1972
Total	11,252	+164	11,416
Office of the Director	[1] 1,893	−50	1,843
National Institute of Allergy and Infectious Diseases	665	−42	623
National Institute of Arthritis, Metabolism, and Digestive Diseases	597	−12	585
National Cancer Institute	1,426	+239	1,665
National Institute of Child Health and Human Development	435	+47	482
National Institute of Dental Research	289	−1	288
National Institute of Environmental Health Sciences	220	+15	235
National Eye Institute	92	+25	117
National Institute of General Medical Sciences	164	+3	167
National Heart and Lung Institute	584	+34	618
National Institute of Neurological Diseases and Stroke	583	−26	557
Clinical Center	1,461	−66	1,395
Fogarty International Center	47	+12	59
Division of Biologics Standards	264	−14	250
Division of Computer Research and Technology	281	−11	270
Division of Research Grants	417	−10	407
Division of Research Resources	83	−5	78
Division of Research Services	552	−23	529
Bureau of Health Manpower Education	737	+46	783
National Library of Medicine	462	+3	465

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[1] Includes NIH Central Services and Program Direction functions.

NATIONAL INSTITUTES OF HEALTH APPROPRIATIONS FISCAL YEAR 1972

(In thousands of dollars)

	TOTAL	RR[1]	NIAID	NIAMDD	NCI	NICHD	NIDR	NIEHS	NIGMS
Total	$2,218,666	$74,981	$109,118	$153,337	$378,794	$116,427	$43,388	$26,436	$173,474
Grants	985,170	71,586	76,237	123,977	146,991	78,356	28,375	16,131	163,031
Research	788,458	71,079	62,986	101,917	126,569	63,592	21,096	12,547	99,099
Fellowships	51,387	134	3,794	6,084	3,948	4,013	1,697	280	17,561
Training	145,325	373	9,457	15,976	16,474	10,751	5,582	3,304	46,371
Direct Operations	438,875	3,395	32,881	29,360	179,803	38,071	15,013	10,305	10,443
Direct research	114,931		18,082	18,127	20,338	12,068	6,847	7,312	
Research contracts	227,718	1,430	10,300	5,584	121,332	20,533	5,500	2,054	4,816
Collaborative studies	42,981		2,118	945	31,022	716	330		
Biometry & epidemiology	4,592			1,053		603	938		
Biologics standards	7,217								
Research management	39,527	1,965	2,381	3,651	7,111	4,151	1,398	939	5,627
International center	1,909								
Construction	52,000				52,000				
Health Manpower Education[2]	677,671								
Health manpower	673,671								
Health professions	460,449								
Dental health	11,859								
Nursing	144,899								
Public health	19,044								
Allied health	30,660								
Program direction	6,760								
Loan funds	4,000								
National Library of Medicine	24,127								
Office of the Director	11,712								
Buildings and Facilities	3,656								
Scientific Activities Overseas[3]	25,545								

NATIONAL INSTITUTES OF HEALTH APPROPRIATIONS FISCAL YEAR 1972

(In thousands of dollars)

	NHLI	NINDS	DBS	FIC	BHME [2]	NLM	NEI	OD	B&F	SAO [3]
Total	$232,627	$116,731	$9,294	$4,307	$677,671	$24,127	$37,132	$11,712	$3,565	$25,545
Grants	161,608	86,542		2,398			29,939			
Research	135,624	68,435		531			24,984			
Fellowships	7,283	2,949		1,867			1,777			
Training	18,701	15,158					3,178			
Direct Operations	71,019	30,189	9,294	1,909			7,193			
Direct research	18,097	10,808					3,252			
Research contracts	43,697	8,351	2,077				2,044			
Collaborative studies		7,850								
Biometry & epidemiology	1,544						454			
Biologics standards			7,217							
Research management	7,681	3,180					1,443			
International center				1,909						
Health Manpower Education[2]					677,671					
Health manpower					673,671					
Health professions					460,449					
Dental health					11,859					
Nursing					144,899					
Public health					19,044					
Allied health					30,660					
Program direction					6,760					
Loan funds					4,000					
National Library of Medicine						24,127				
Office of the Director								11,712		
Buildings and Facilities									3,565	
Scientific Activities Overseas[3]										25,545

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[1] Formerly General Research and Services (GR&S); now Research Resources.

[2] Formerly Bureau of Health Professions Education and Manpower Training; now Bureau of Health Manpower Education.

[3] Special foreign currency program (PL 480) included in NIH budget for administrative purposes.

NIH GRANTS AND AWARDS BY NIH COMPONENT AND PROGRAM, FISCAL YEAR 1972 [1]

(Amounts in millions of dollars)

NIH component	Total amount	Research grants [2]		Research contracts [3]		Research training grants		Research fellowships, traineeships [4]		Research career program awards		Education grants [5]		Construction grants		Medical library grants	
		No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.
Total	$1,766.1	11,524	$805.0	1,799	$270.6	2,047	$138.2	2,420	$22.3	1,158	$27.7	4,549	$433.2	44	$66.4	379	$2.7
I/RD	1,247.8	11,412	797.7	1.406	220.5	2,024	136.2	2,264	21.6	1,156	27.7	—	—	17	44.1	—	—
NIAID	79.5	1,174	58.3	113	8.8	154	8.9	95	0.9	109	2.6	—	—	—	—	—	—
NIAMDD	120.8	2,009	93.6	80	6.5	275	15.0	215	2.1	148	3.7	—	—	—	—	—	—
NCI	300.9	1,504	120.6	522	115.8	216	16.6	197	1.9	85	2.0	—	—	17	44.1	—	—
NICHD	94.1	978	60.7	221	19.6	137	10.0	89	0.9	119	2.8	—	—	—	—	—	—
NIDR	32.5	271	20.7	46	5.3	90	5.2	64	0.8	26	0 6	—	—	—	—	—	—
NIEHS	16.5	140	12.1	15	1.0	35	3.1	12	0.1	8	0.2	—	—	—	—	—	—
NEI	30.2	469	23.3	9	2.2	48	3.0	107	1.3	18	0.4	—	—	—	—	—	—
NIGMS	154.7	1,212	92.8	9	2.7	470	43.5	879	7.0	383	8.6	—	—	—	—	—	—
NHLI	192.0	1,597	126.4	259	40.6	360	18.5	145	1.4	180	5 0	—	—	—	—	—	—
NINDS	89.6	1,339	63.8	74	8.8	229	12.0	275	3.2	80	1.8	—	—	—	—	—	—
DRR	128.5	719	125.4	17	2.6	10	0.4	12	0.1	—	—	—	—	—	—	—	—
FIC	1.9	—	—	—	—	—	—	174	1.9	—	—	—	—	—	—	—	—
DBS	1.7	—	—	27	1.7	—	—	—	—	—	—	—	—	—	—	—	—
DRS, DCRT	0.2	—	—	6	0.2	—	—	—	—	—	—	—	—	—	—	—	—
CC, OD, JOINT ..	4.7	—	—	8	4.7	—	—	—	—	—	—	—	—	—	—	—	—
BHME	507.6	66	6.3	325	44.3	12	0.9	149	0.6	2	—	4,549	433.2	27	22.3	—	—
OD	25.7	8	3.0	69	17.4	—	—	—	—	—	—	45	5.3	—	—	—	—
DAHM	43.7	—	—	79	4.2	—	—	—	—	—	—	1,023	39.5	—	—	—	—
DDH	9.4	10	0.5	50	4.1	5	0.2	3	[6]	2	[6]	75	4.5	—	—	—	—
DMI	3.6	—	—	35	3.6	—	—	—	—	—	—	—	—	—	—	—	—
DN	130.1	44	2.3	55	8.7	7	0.7	146	0.6	—	—	2,462	106.3	21	11.4	—	—
DPHPE	295.2	4	0.5	37	6.3	—	—	—	—	—	—	944	277.6	6	10.9	—	—
NLM	10.8	46	1.0	68	5.9	11	1.1	7	0.1	—	—	—	—	—	—	379	2.7

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[1] Excludes scientific evaluation grants.

[2] Includes General Research Support programs.

[3] Includes contracts awarded by the National Library of Medicine for technical development, and also training and development contracts awarded by the Bureau of Health Manpower Education.

[4] Includes NINDS traineeships.

[5] Includes institutional grants (formula), special project grants, and awards for student assistance.

[6] Less than $50 thousand.

Note: Dollars may not add due to rounding. Supplemental grants are combined with parent grants or with other supplements when both awards are financed from the same fiscal year funds.

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